Volume 21, Number 14 July 31, 1967

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 24067, 24113, 24409, and 24890.

23812 (BM-RI-6936) ISOTOPIC ABUNDANCE OF NEON, ARGON, AND NITROGEN IN NATURAL GASES. Relationship to Helium Genesis. Stroud, Lowell; Meyer, Thomas O.; Emerson, David E. (Bureau of Mines, Amarillo, Tex. Helium Research Center). Oct. 1966. 32p.

Ten natural gases containing from 0.023 to 8.4 percent helium were investigated. In seven high-helium samples, the isotopic abundance of ^{21}Ne was greater than in the atmosphere, being supplemented by 33 to 85 percent of excess or radiogenic ^{21}Ne. The ratio of $^{4}He/^{21}Ne_{(rad)}$ in these gases was evaluated and found to vary between 2.9×10^{7} and 5.9×10^{7}, a factor of approximately 2. Argon concentrations were determined by the isotope dilution method. The isotopic ratios of $^{40}Ar/^{36}Ar$ in the high-helium gases were from 5 to 75 times the atmospheric value, with the ^{40}Ar being about 80 to 99 percent radiogenic in nature. The ratios of $^{4}He/^{40}Ar_{(rad)}$ in all 10 gases were evaluated and found to range from 4 to 18. The isotopic ratio of $^{14}N/^{15}N$ in four of the high-helium gases was essentially the same as in the atmosphere; in three cases it was approximately 5 percent higher than the atmospheric value of 272.0. The genesis of nitrogen and the relationship of nitrogen to helium in natural gases were reviewed and are discussed in terms of a theory for the concurrent generation of nitrogen, helium, radiogenic neon-21, and petroleum (hydrocarbon gases and liquids). (auth)

23813 (BNWL-SA-1173) ION EXCHANGE EQUILIBRIA OF TRACE ^{137}Cs AND ^{85}Sr IN MULTICOMPONENT SYSTEMS. Mercer, B. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 16, 1967. Contract AT(45-1)-1830. 26p. (CONF-670401-9). Dep. CFSTI.

From 153rd National Meeting, American Chemical Society, Miami Beach, Fla.

Trace cesium and strontium selectivity coefficients were determined for 20 cation exchangers at two or more different concentrations of competing cations. The selectivity coefficients are useful for computing equilibrium distribution coefficients, Kds, for dilute electrolyte solutions such as these encountered in radioactive waste treatment or radiochemical analysis by ion exchange. A variety of inorganic ion exchangers with high cesium selectivity were studied. These exchangers may be used in place of conventional organic ion exchange resins when high cesium Kds are desired in systems with significant concentrations of competing cations. Several of the inorganic ion exchangers also show high strontium selectivity in the presence of divalent cations Mg^{2+} and Ca^{2+}. Since practical application of ion exchange theory is often complicated by the presence of two or more competing ions, equations are derived for computing distribution coefficients in multicomponent systems. The derivation of the equations is based on the independence of the binary exchange equilibria of one ion pair from other ion pairs in the system. Trace ion selectivity coefficients determined in binary systems are used in the equations for computing distribution coefficients in multicomponent systems. Good agreement was obtained between computed and experimental distribution coefficients. (auth)

23814 (CEA-R-3100) ANALYSE PAR ACTIVATION DE L'ARGON: APPLICATION A LA DATATION PAR LA METHODE POTASSIUM–ARGON. (Argon Activation Analysis: Application to Dating by the Potassium–Argon Method). Dumesnil, Patrice (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1967. 70p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

Activation analysis using ^{40}Ar was applied to rock-dating by the K–Ar method. Argon is extracted from the sample, purified, activated to saturation in a flux of 2×10^{13} neutrons/cm^2/sec^{-1}, and measured by gamma spectroscopy. The sensitivity obtained is such that it is possible to measure amounts of argon corresponding to an age of a few thousand years only. However, since it was not possible to measure the amount of pollution of radiogenic argon by atmospheric argon with any accuracy, the measurable age limit is of the order of millions of years. The method was applied to basalts from the Mont-Dore region. The results obtained are in fairly good agreement with geological, stratigraphic, and paleomagnetic data. (auth)

23815 (CEA-R-3132) LIGNE D'INTRODUCTION POUR SPECTROMETRE DE MASSE: APPLICATION A L'ANALYSE DES IMPURETES CONTENUES DANS L'UF_6. (Mass Spectrometer Introduction Line: Application to the Analysis of Impurities in Uranium Hexafluoride). Besson, Marc (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1967. 124p. (In French). Dep.

The continuous mass-spectrometric analysis of impurities in UF_6 is possible industrially if certain conditions imposed by the nature of the gas are respected. The gas introduction line arriving at the spectrometer's source makes it possible to fix the flow rate, to control the inlet pressure, and to selectively destroy the gas containing the impurities. Operational conditions for the line are defined and a description is given of theoretical and experimental studies of the various elements of which it is composed, i.e., the leak valve, the flowmeter, the chemical trap, and the servomechanism making it possible to regulate and control the gas flow. The dynamic characteristics of the line's various components and the performance of the equipment in the case of the analyses considered are given. (auth)

23816 (CEA-R-3140) LES TITRAGES SPECTROPHOTOMETRIQUES: APPLICATION A LA DETERMINATION DE QUELQUES ELEMENTS DANS LES SOLUTIONS D'URANIUM. (Spectrophotometric Titrations: Application to the Determination of Some Elements in Uranium Solutions). L'Her, Maurice (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan. 1967. 116p. (In French). Dep.

Thesis. Submitted to Paris Univ. (France). Faculte des Sciences.

Application of spectrophotometric titrations to the analysis of uranium-containing solutions is discussed. The general principles involved in these titrations are outlined. Spectrophotometric titrations are first considered from a general point of view; their fundamental principle and practical execution, as well as the various possibilities of the method, are examined. Advantages of titration are examined, in particular that of lending itself simultaneous determination of two species. The possibility of applying these spectrophotometric titrations to the analysis of uranium-containing solutions is considered: the dosage of a few species in uranium (VI) solutions is described. In an experimental appendix the equipment is described. (auth)

23817 (CEA-R-3186) APPLICATION DE LA POLAROGRAPHIE A LA DETERMINATION DE LA COMPOSITION D'OXYDES

D'URANIUM. (Polarography Applied to the Determination of Uranium Oxide Composition). Nens, Chantal; Canton, Claude; Molina, Roger (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1967. 31p. (In French). Dep.

An analytical method based on conventional polarography was developed for determination of the O/U ratio in uranium oxides. The dissolution of the samples is effected by means of molten ammonium bifluoride. After a transfer to aqueous solution, polarography is used to determine the oxide composition by measurement of both the hexavalent and the total uranium. (auth)

23818 (EUR-1898.e(Add.1)) FIRST ADDENDUM TO THE DATA HANDBOOK FOR SENSITIVITY CALCULATIONS IN NEUTRON ACTIVATION ANALYSIS. Girardi, F.; Guzzi, G.; Pauly, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1966. 28p. Dep.

This addendum covers three analyses by secondary reactions with triton particles. They can easily be obtained with thermal neutrons and were therefore included. The reaction $^{209}Bi(n,\gamma)^{210}Bi$ was also added as analytically significant. Nine sensitivity sheets for short-lived isotopes are included to be substituted for the existing sheets. The sensitivity data were modified to take into account the decay of the isotope during the counting. A counting time of two half-lives was used, instead of the previously adopted ten minutes, for isotopes with half-lives shorter than five minutes, in order to obtain a higher sensitivity. (auth)

23819 (ISO-495) GAMMA SCINTILLATION SPECTROMETRY. Zimmer, W. H. (Isochem Inc., Richland, Wash.). Dec. 1966. Contract AT(45-1)-1851. 64p. Dep. CFSTI.

A method of analysis using gamma scintillation spectrometry is discussed. Equipment and methods of operation are described to assist in the establishment of a gamma energy analytical system, or to troubleshoot an existing system. The capabilities of the 7090 computer programs, MasMat (Master Matrix) and AMI (Analysis of Mixed Isotopes), are presented as one method of digesting the complex data generated. (auth)

23820 (JINR-P12-3243) OPREDELENIE KONTSENTRATSII DELYASHCHIKHSYA VESHCHESTV V TVERDYKH TELAKH. (Determination of the Fissionable Material Concentration in Solids). Abdullaev, Kh.; Kapustsik, A.; Otgonsuren, O.; Perelygin, V. P.; Chultem, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 14p. (In Russian). Dep.

A technique was developed for the determination of fissionable material concentration with the accuracy up to ±10% in the solids with known chemical composition. The technique is based on the use of charged-particle detectors, such as muscovite, mica, silicate glass, mylar and polycarbonate, for which the dependencies of effective fission fragment range $R_{ef.}$ on the atomic number Z of the medium investigated were obtained. (auth)

23821 (N-67-13662) STUDIES ON THE RADIOACTIVE DATING OF THE LUNAR SURFACE. Final Report. Eberhardt, P.; Geiss, J. (Bern Univ. (Switzerland). Physikalisches Institut). Aug. 1966. 15p. (NASA-CR-80730). CFSTI.

The feasibility of remote-controlled rare gas analysis was investigated in an effort to develop a simple, lightweight, rugged rare gas extraction and purification system with negligible external power consumption. A high-temperature extraction system with a chemical reaction as a heat source was examined. Thermite, a mixture of iron oxide and aluminum, was used as the energy source. Temperatures higher than 1500°C were reached, and the heat of solidification of the molten iron prolonged the period of time the sample was at high temperature. A molybdenum extraction crucible lined with titanium sponge and containing a graphite liner was used. Total weight of the system is less than 500 g, the diameter is 7 cm, and the length is 13 cm. Performance of the extraction system is discussed. (STAR)

23822 (PEL-121(Vol.5), pp 532-47) REVIEW OF CHEMICAL METHODS OF ANALYSIS REQUIRED FOR THE PRODUCTION OF URANIUM. Stoch, H.; Steele, T. W. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Analytical procedures used for testing raw materials, digest liquors, and plant products that are obtained for the production of uranium metal are reviewed. The determination of trace impurities in uranium metal is described for the following 17 elements: Cu, Co, Cr, Fe, Ni, Mn, Mo, Ti, V, B, Cl, N, S, Th, As, C, and Si. (P.C.H.)

23823 (PEL-121(Vol.5), pp 552-60) THE CARRIER-DISTILLATION METHOD FOR THE DETERMINATION OF IMPURITIES IN URANIUM. Watson, A. E.; Steele, T. W. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The carrier-distillation technique for the spectrographic analysis of 26 elements in uranium is described. Some of the problems encountered and the limitations of the method are discussed. (auth)

23824 (PEL-121(Vol.5), pp 561-8) SPECIAL TECHNIQUES USED FOR THE SPECTROGRAPHIC DETERMINATION OF CERTAIN IMPURITIES IN URANIUM. Watson, A. E.; Steele, T. W. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Special procedures used for the spectrographic determination of certain impurities in uranium, which are not determined by the standard carrier-distillation technique, are presented and discussed. Methods are described for the determination of rare earths, Ca, Zr, Ta, Nb, and W in U and B in ammonium uranous fluoride. (P.C.H.)

23825 (RFP-880) GAS CHROMATOGRAPHIC INVESTIGATIONS FOR THE DETERMINATION OF FLUORINE AND OXYGEN IN MIXTURES. DeGrazio, Robert P.; Auge, Robert G. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Apr. 12, 1967. Contract AT(29-1)-1106. 15p. Dep. CFSTI.

Various methods were investigated for the determination of fluorine and oxygen in gas mixtures by gas chromatographic techniques. The technique found to be successful involves the quantitative conversion of fluorine to chlorine by the reaction with sodium chloride and the subsequent separation and detection of chlorine and oxygen. (auth)

23826 (UCID-15137) DETERMINATION OF NITRATE IN PLUTONIUM SOLUTIONS. Bystroff, R. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 18, 1965. Contract W-7405-eng-48. 13p. Dep. CFSTI.

A procedure for the determination of nitrate in highly concentrated plutonium solutions based on Auger's method of reduction of the nitrate to ammonia and distillation into a boric acid holding solution is described. The determination is precise to ±0.5% and is compared to an alternate ion exchange method. (auth)

23827 RAPID DETERMINATION OF RADIONUCLIDES BY HIGH-VOLTAGE ELECTROPHORESIS. Peter, G. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Atompraxis, 13: 116-17(Mar. 1967). (In German).

High-voltage electrophoresis was used for the separation of inorganic cations. The best conditions for the separation were established in experiments with inactive elements (Sr, Cs, Y, Ba, Ca, Ce, La, Zr), and were applied to the separation of radionuclides. The example of the ^{90}Sr- and ^{137}Cs-determination demonstrates that the given activities can be determined with an accuracy of 90%. It takes approximately 2 hours for a complete determination. (auth)

23828 ANALYSIS OF PURE MATERIALS: SOME GENERAL COMMENTS. Smales, A. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Mater. Sci., 1: 302-7(Aug. 1966).

The use of absorption, fluorescence, emission, fluorescent x-ray, and mass spectroscopy; nuclear magnetic resonance; radioactive tracers; neutron activation; and other methods for analysis of pure materials, particularly those used in nuclear research, is reviewed. Some desirable characteristics of analytical techniques are listed. Fluorescence spectroscopy, an individual element method, offers a potential improvement in sensitivity over straight absorption spectroscopy, ~10^{-7} g is a likely level. The use of the yellow fluorescence of hexavalent U in a solid phosphor of sodium fluoride is cited as an example of a highly sensitive, highly specific method of determining as little as 10^{-9} g. Emission spectroscopy is important in nuclear energy work. Its advantages are that several elements may be determined simultaneously, in some cases directly on the sample material. X-ray fluorescence spectroscopy has the advantages in the ability to carry out nondestructive analysis on small samples for several elements; for some materials, such as Be, at the level of 10 to 100 ppM. In combination with mass spectrometry, isotope dilution proved to be a sensitive method (another is radioactivation); sensitivity down to 10^{-12} g or less is possible, and sensitivity down to 10^{-9} g was obtained at Harwell for many elements. Radioactivation is one of the most sensitive methods available and has the additional advantage of being free from the reagent blank problem. Sensitivity varies for each element, but with a neutron flux of 10^{12} n/cm^2 sec a wide range of elements can be determined at levels between a microgram and a picogram. Irradiation of a sample followed by autoradiography may be of help in location of impurities in suitable materials. (BBB)

23829 MICRO-THERMOBALANCE FOR THE ANALYSIS OF IRRADIATED NUCLEAR FUELS. Lyon, W. L. (General Electric Co., Pleasanton, Calif.). Nucl. Appl., 3: 324-5(May 1967).

A sensitive thermobalance was constructed for the gravimetric analysis of small samples of irradiated oxide fuels. Its utility was

demonstrated by measuring the oxygen-to-metal ratio in specific regions within failed fuel elements, or at specific radial locations within fuel that has undergone the steep thermal gradient attendant within irradiation in a high neutron flux. (auth)

23830 DETERMINATION OF MANGANESE IN TISSUES BY NEUTRON ACTIVATION ANALYSIS. Hahn, Kwang J.; Haven, Mary C.; Tuma, Dean J.; Ogborn, Richard E.; Qualfe, Merton A. (Veterans Administration Hospital, Omaha). Nucl. Appl., 3: 314-16(May 1967).

A technique for determining the manganese concentration of tissue utilizing a histological preparation of the tissue and neutron activation analysis is reported. A study was undertaken to investigate the effect of varying the standardized procedure in a manner that might be anticipated in actual application and to determine whether manganese was washed out of the tissue. It was found that some manganese was washed out of rat tissue during the Autotechnicon process. Results indicated that the standard method should not be varied. (auth)

23831 INTERFERENCE REDUCTION AND SENSITIVITY IMPROVEMENT IN ACTIVATION ANALYSIS. Holm, Dale M.; Sanders, W. Mort (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl., 3: 308-13(May 1967).

In activation analysis with photons and charged particles, the activities of positron-emitting reaction products are determined by unfolding complex decay curves obtained from a pair of coincidence detectors. Certain interfering reaction products emit a high-energy gamma ray coincident with the positron, and the signal from these was distinguished from the signal from pure positron emitters by collecting a 0.51-MeV annihilation photon in one detector and the other 0.51-MeV annihilation photon plus the high-energy gamma in the other detector. Since improvement in sensitivity is directly related to interference removal, which increases with the probability of detecting the associated gamma ray, high efficiency was required. The method is illustrated by a photon activation analysis experiment in which oxygen was measured in sodium. The activation product, ^{15}O, is the signal and ^{22}Na and ^{38}K are the interference reaction products. Experiments show that a large (8-in.-dia × 12-in.-long) "well" detector will give five-fold sensitivity improvement over a 2.3- × 6-in. detector when each is in coincidence with a 2- × 2-in. detector. A time sequence of coincidence-gated spectra was taken, and the counts in specified energy increments were determined. Composite decay curves were constructed and unfolded into components. The large detector causes counts from the interference reaction products, which would appear in the 0.51-MeV annihilation peak, to appear in the higher energy portion of the spectrum because of the high probability of collecting additional energy from the associated gamma rays. (auth)

23832 NEUTRON ACTIVATION ANALYSIS OF POTASSIUM IN BIOLOGIC MATERIAL WITH THE USE OF A NEW SEPARATION METHOD. Rakovic, M.; Prochazkova, Z. (Charles Univ., Prague). Nucl.-Med., 5: 436-40(1966). (In German).

A new procedure is described for separating potassium-42 in the form of the perchlorate in neutron activation analysis of biological samples. Compared to the classic procedure used in gravimetry (evaporation with $HClO_4$ to a small volume) precipitation with 20% $HClO_4$ at room temperature is used. The product thus obtained is radiochemically purer, and the separation is more rapid than in the classic procedure. An optimum of the sodium holdback carrier concentration has been found. The method described has been used to determine potassium in blood samples. (auth)

23833 DETERMINATION OF GOLD SOL CONCENTRATIONS FROM SPECTROPHOTOMETRIC DATA. Caro, R. A.; Nicolini, J. O.; Radicella, R. (Univ. of Buenos Aires). Int. J. Appl. Radiat. Isotop., 18: 327-9(May 1967).

A procedure to determine the gold sols concentration by absorption spectrophotometry is presented. It is based on the Mie theory of the optical behavior of gold sols with different particle sizes. By determining at 526 mμ the optical density of the colloidal suspension the concentration of gold sols with particle diameters between 30 and 400 Å can be estimated with an accuracy of approximately 10%. These sizes are those of the commonly used radiogold colloids. (D.H.M.)

23834 ACTIVATION OF SHORT-LIVED ISOTOPES. RAPID SEPARATION BY EXCHANGE ON MERCURY. EXCHANGE BETWEEN MERCURY AND MERCURY IONS. Monnier, D.; Loepfe, E. (Univ., Geneva). Anal. Chim. Acta, 37: 339-49(Mar. 1967). (In French).

The exchange of mercury ions and of certain organic mercury complexes with a drop of mercury was studied systematically by means of radioactive isotopes. Under defined conditions, the exchange is quantitative, very rapid and selective; most other ions remain in solution so that traces of mercury can be determined by neutron activation. Only ions with higher oxidation potentials than mercury interfere. (auth)

23835 • FLUORIMETRIC DETERMINATION OF THORIUM WITH FLAVONOL. Bottei, Rudolph S.; D'Alessio, Ana S. (Univ. of Notre Dame, Ind.). Anal. Chem. Acta, 37: 405-9 (Mar. 1967).

A study was made of the fluorescence of the thorium–flavonol system and its application to monazite materials. The method was found to have a good sensitivity even for concentrations of a few μg of thorium in 100 ml of solution. For example, 6 μg of Th in 100 ml of solution had a sensitivity of 0.08 μg per meter reading with a standard deviation of 3.6%, i.e., a 0.4-μg limit of detection at a 95% confidence level. (M.C.G.)

23836 SEMIQUANTITATIVE AUTORADIOGRAPHIC DETERMINATION OF ^{14}C ACTIVITY IN THE pC RANGE BY MEANS OF THE RING OVEN. Weisz, H.; Klockow, D. (Univ., Freiburg i. B.). Anal. Chim. Acta, 37: 370-3(Mar. 1967). (In German).

Use of the ring-oven method for semiquantitative autoradiographic determination of ^{14}C-labelled compounds is described. Satisfactory results can be obtained in the activity range from 9.2 to 460 pCi/μl (exposure times of 1.22 to 2 hr) with special commercial films. (auth)

23837 ATOMIC ABSORPTION STUDIES ON RARE EARTH AND REFRACTORY METALS. Jaworowski, R. J.; Weberling, R. P.; Bracco, D. J. (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Anal. Chim. Acta, 37: 284-94(Mar. 1967).

The use of atomic absorption spectroscopy for analysis of rare earth and refractory metals was studied. Various types of burners and fuel-oxidant mixtures were examined. The effects of organic solvents, sample solution flow rates, and the use of continuous light sources on sensitivity are noted. Neodymium, samarium, europium, gadolinium, terbium, erbium, dysprosium, yttrium, vanadium, chromium, aluminum, and zirconium were included in this investigation. (auth)

23838 SPECTROPHOTOMETRIC DETERMINATION OF THORIUM WITH ARSENAZO III IN THE ORGANIC PHASE AFTER EXTRACTION WITH DI-(2-ETHYLHEXYL)ORTHOPHOSPHORIC ACID. Cerrai, E.; Ghersini, G. (Laboratori CISE, Milan). Anal. Chim. Acta, 37: 295-309(Mar. 1967).

A simple, direct colorimetric determination of thorium extracted from chloride solution with bis(2-ethylhexyl) ester of orthophosphoric acid is described; the color is developed in the organic phase by adding arsenazo III and then isopropanol. Two different procedures are outlined for different thorium levels; maximum absorbance occurs at 660 nm and Beer's law is obeyed within limited ranges. Molar extinction coefficients for the two methods are 4.93×10^4 and 8.77×10^4, respectively. With the more sensitive method, 0.696 μg Th/ml was determined with 0.0028 as the standard deviation. The effects of the various parameters were studied. Among 69 foreign cations tested serious interferences are U(VI), Se(IV), Ti(IV), and the rare earths. Of the common anions, only large amounts of sulfate interfered. Several ways of overcoming interferences are suggested, with particular reference to uranium. Several extensions of the method are outlined; 2 ppB Th in aqueous media can be determined by modifying the extraction step. The procedure also appears to be extremely sensitive for the light rare earth elements. (auth)

23839 PRECISE COMPLEXIMETRIC TITRATION OF URANIUM(VI). Brueck, A.; Lauer, K. F. (EURATOM, Geel, Belg.). Anal. Chim. Acta, 37: 325-31(Mar. 1967).

The complexiметric reaction of uranium (VI) with EDTA was studied. A method is described for determining uranium (VI) with PAN as an indicator and without an indicator by titration in the ultraviolet region. With the described technique, quantities of uranium varying from 12 μg to 9 mg can be determined. The coefficients of variation vary from 5 to 0.1%, respectively. (auth)

23840 APPLICATION OF X-RAY DIFFRACTION ANALYSIS TO URANIUM CERAMICS. PART I. QUANTITATIVE ANALYSIS OF THE BINARY MIXTURE UO_2–U_3O_8. Conti, R.; Toussaint, C. J.; Vos, G. (EURATOM-CCR, Ispra, Italy). Anal. Chim. Acta, 37: 277-83(Mar. 1967).

An x-ray diffraction method is proposed for quantitative analysis of the binary mixture UO_2–U_3O_8. Diffractometer and Debye–Scherrer camera techniques were compared; the former is preferable whenever sufficient sample is available. The relative standard deviation was found to be 1%. (auth)

23841 LOW-LEVEL ^{36}Cl DETECTION WITH LIQUID SCINTILLATION TECHNIQUES. Ronzani, C.; Tamers, M. A. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Radiochim. Acta, 6: 206-10(Dec. 1966).

Low level activities of naturally occurring ^{36}Cl can be detected with the liquid scintillation counter. The most sensitive systems are obtained with solutions of silicon tetrachloride, the synthesis of which can be completed in less than eight hours. All of the chlorine of this compound comes from the material to be measured. The principal advantages of silicon tetrachloride are that it has a density of 1.47, is not a quencher for the scintillations, is stable, and contains 83% chlorine. It can be used in concentrations up to 55% by volume of the counting solutions. The calibration of the counter is discussed and the characteristics for different solutions are illustrated. It is seen that the figure of merit increases with the percentage of silicon tetrachloride used, despite decreasing counting efficiencies. The lower limits of ^{36}Cl dating overlap considerably the upper limits of ^{14}C dating. In principle, the entire Pleistocene period could be covered by ^{36}Cl. Contamination from nuclear weapons fallout will present a problem, but this can be avoided with certain types of materials. (auth)

23842 THE APPLICATION OF 2.8-MeV (D,d) NEUTRONS TO ACTIVATION ANALYSIS. Broadhead, K. G.; Shanks, D. E. (Dept. of Interior, Reno, Nev.). Int. J. Appl. Radiat. Isotop., 18: 279-83(May 1967).

The analytical application of 2.8-MeV neutrons produced by the $^{2}H(d,n)^{3}He$ reaction in a neutron generator is described. These neutrons, though not energetic enough to produce the usual fast neutron reactions, do induce useable $(n,n'\gamma)$ reactions. Cross sections are given for thirteen elements most amenable to this reaction. Examples are given of the determination of bromine, yttrium, and barium in complex matrices to illustrate potential uses in activation analysis. (auth)

23843 QUASI-CONTINUOUS MEASUREMENT OF SMALL CONCENTRATIONS OF SO_2 IN WASTE GASES BY SOFT-γ ABSORPTION ANALYSIS. Dresia, H.; Bannke, W.; Hallen, D.; Hilgers, W.; Mueller, Dieter (Staatl. Ingenieur-Schule fuer Maschinenwesen, Essen). Chem.-Ing.-Tech., 39: 465-70(Apr. 25, 1967). (In German).

γ-absorption is suitable for determination of SO_2 concentrations of the order of a few tenths of a vol. %. If the concentration is lower than 0.5 vol. % the SO_2 must be concentrated in an absorbent. This role is better filled by hydrogen peroxide than by cyclohexanone, for, although the former has a larger absorption cross section for γ quanta, the SO_2 is bonded chemically and no desorption can take place. The method is somewhat less accurate than gravimetric analysis but has the advantage that it may be used for quasi-continuous operation. (auth)

23844 NUCLEAR TECHNIQUES IN FORENSIC SCIENCE. Coleman, R. F. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Brit. Nucl. Energy Soc., 6: 134-8(Apr. 1967).

The value of nuclear methods in forensic science is discussed and illustrated with many examples. The techniques provided information in toxicological studies of heavy metals, particularly arsenic. The detection of gun residues assists in interpretation of cases involving firearms in several ways. The value of the techniques in establishing a common origin in samples is indicated, and specifically applied to providing a quantitative assessment of hair comparison by trace element analysis. (UK)

23845 SOLVENT EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF THE PERTECHNETATE ION WITH METHYL VIOLET. Fujinaga, Taitiro; Koyama, Mutsuo; Kanchiku, Yoshihiko; Tsurubo, Shigeo (Kyoto Univ.). Bull. Chem. Soc. Jap., 40: 817-21(Apr. 1967).

A spectrophotometric method of determination of TcO_4^- subsequent to solvent extraction with Methyl Violet was investigated. Methyl violet which has a molar extinction coefficient of about 2×10^5 at 585 mμ in a neutral aqueous solution was found to be extractable with TcO_4^- into monochlorobenzene. The absorption maximum of the dye in the organic layer after extraction shifted to 595 mμ, at which point the absorbance was proportional to the amount of TcO_4^- added to the aqueous solution. The effect of the pH on the absorbance of organic layer was very small as long as the absorbance was measured against the reagent blank as a reference. Over the wide range of pH values from 2 to 10, an approximately constant absorbance was obtained for a fixed amount of TcO_4^-. Effects of diverse ions were also examined. Alkali salts of phosphate, borate, citrate, and tartrate had little effect on the absorbance of the organic layer, whereas perchlorate and perrhenate seriously interfered. When the extraction efficiencies of TcO_4^- were measured using ^{95m}Tc and ^{97m}Tc as tracers, they were found to be quantitative, even at a concentration as low as 10^{-12} M. (auth)

23846 LIQUID SCINTILLATION COUNTING OF $^{14}CO_2$ IN AQUEOUS CARBONATE SOLUTIONS MODIFICATION OF HARLAN'S METHOD. Yamada, Sadayoshi (Japan Monopoly Corp.). Radioisotopes (Tokyo), 16: 149-55(Apr. 1967). (In Japanese).

Harlan's method for liquid scintillation counting of $^{14}CO_2$ was modified to achieve rapid sample preparation and optimum counting results for $^{14}CO_2$ in aqueous $Na_2{}^{14}CO_3-NaOH$ sample solutions, in which total concentration of Na_2CO_3 and NaOH ranged from 0.2 to 1.0N and carbonate fraction normality varied from 10 to 50%. The original procedure for sample preparation was not simple enough to prepare many samples. It also had a possibility of error owing to use of eye-measured gel powder. An attempt was made to find an improved procedure. Various scintillator solutions were examined to select the optimum one. Scintillation mixtures subjected to examination were counted in a liquid-scintillation spectrometer and the sample chamber was kept at 5°C. As a result, the following modified procedure was found to be advantageous for rapid sample preparation and accurate counting of the samples. Four hundred milliliters of absolute ethanol and 25g of the gel powder were mixed and the resultant slurry partially diluted with toluene. The mixture, 4g of PPO, and 15mg of POPOP were placed in a 1-liter volumetric flask and again diluted to the mark with toluene. A counting sample was made up by mixing 15ml of the scintillator solution and 0.5ml of a $Na_2{}^{14}CO_3-NaOH$ sample solution in the standard glass counting vial. A piece of aluminum foil was attached on top of the vial prior to capping, if protection of the vial cap against contamination was desired. The scintillation mixtures were counted in the counter at a gain setting of 21 with window openings of 50 to 1000 to obtain maximum counting efficiency. The aluminum foil attached on top of a vial increased counting efficiency by 2%. With this effect included, the mean counting efficiency over scintillation mixtures, which were made up in four combinations of total alkalinity and carbonate fraction levels, was 73.5%. Counting efficiency increased within the range of ±0.6% from the mean as total alkalinity and carbonate fraction increased. Background was about 65 cpm. (auth)

23847 TRIAL METHOD OF DETERMINING URANIUM AND THORIUM CONTENT IN ROCKS BY THE RADIOACTIVE MEASUREMENTS, 3. Nishimura, Susumu; Hatuda, Zin'itiro; Asayama, Tetsuji (Univ. of Osaka Prefecture, Univ. of Kyoto). Radioisotopes (Tokyo), 16: 156-60(Apr. 1967). (In Japanese).

With basic lavas in radioactive disequilibrium, the content of uranium and thorium was determined by the neutron activation method, and also the contents of ^{214}Pb and ^{212}Pb by gamma spectrometry. These lavas revealed radioactive disequilibrium by means of alpha and gamma interpretation. It seems that the Th/U ratio of basaltic lava of historical age is higher than that of andesitic one, and that the radium content of tholeiite lava is nearly normal as compared with its uranium content, while that of alkali and high-alumina lava is highly excessive. (auth)

23848 NEUTRON ACTIVATION ANALYSIS OF METAL TRACE IMPURITIES IN ASCORBIC ACID. Preliminary Communication. Nagy, Lajos Gyoergy; Mester, Zoltan; Takacs, Geza. Magyar Kem. Foly., 73: 137-8(Mar. 1967). (In Hungarian).

Informatory nondestructive and destructive activation analyses of ascorbic acid samples of different origin showed that the samples contained considerable quantities of aluminum, sodium, and in some cases copper, chromium, and antimony as well. (auth)

23849 REVERSED PHASE PAPER CHROMATOGRAPHY OF METAL IONS WITH PHENYLBENZOHYDROXAMIC ACID. Fritz, James S.; Sherma, Joseph (Ames Lab., Iowa). J. Chromatogr., 25: 153-60(1966). (IS-1295).

The chromatographic behavior of 35 different metal ions was studied using paper impregnated with phenylbenzohydroxamic acid (PBHA) and 2-octanone. A number of selective separations were accomplished using eluents varying in acidity from pH 3 to 5 or 6 molar acid. Some of these separations are also possible by solvent extraction or precipitation with the reagent, but some have not been been described in previous literature. (P.C.S.)

23850 USE OF NUCLEAR (n,γ) REACTION IN DETERMINING CADMIUM CONTENT. Plaksin, I. N.; Malysheva, N. G.; Starchik, L. P. (Inst. of Mining, Moscow). Dokl. Akad. Nauk SSSR, 171: 393-4(Nov. 11, 1966). (In Russian).

Since Cd has a high capture cross section of 2550 barns, it can readily be determined in ores and solutions by neutron irradiation. A Po–Be source with a paraffin moderator and with 150 μCi of activity is used to generate the thermal neutrons. A NaI(Tl) detector is used to count the gamma photons from the induced Cd activity. The Cd content of Cu–Zn concentrates is shown to be a linear function of the count rate. The sensitivity of the method is 0.035%, and the relative error is 3 to 4% for a 1% Cd content. (TTT)

23851 HAIR INDIVIDUALIZATION STUDY BY NEUTRON ACTIVATION. Perkons, Auseklis Karlis. Ontario, Univ. of Toronto, 1965.

Thesis.
Neutron radioactivation, instrumental gamma spectroscopy, and digital computer spectrum analysis were used to determine the trace element content and distribution in 947 human hair samples from 780 individual donors for the purpose of hair individualization studies. In the large majority of cases amounts of 20 elements were determined quantitatively, and the probable presence of 5 or 6 others inferred qualitatively from evident gamma energies, specific decay half-lives and, in some instances, radiochemical separation techniques. Results are presented in the form of concentration distribution histograms for each of the components found, including Na and Zn, which are not strictly trace constituents. Further statistical considerations of the data, collected from a large and varied population give rise to the conclusion that individualization of biological materials such as hair is feasible, using the method developed. It was also shown that analysis of a sample of several hairs in the bundle can single out one particular combination of trace element concentrations in a population of from 10^6 to 10^{10} samples, provided enough hair is available, and there is no excessive time lag between the times of collection of the samples to be compared. In addition to the main study of hair individualization, several trends and influences regarding hair thickness and color and the sex, age, dietary, and environmental factors were investigated. It was found that the color of the hair can generally be correlated with the amounts of Mn, Cu, Ni, Co, and Fe present. Gray hair usually shows a higher Ni content; high Fe levels are associated mostly with black, and even more with red hair, dark hair also having higher Mn, Cu, and Co concentrations. The lower amounts of As, Au and Fe, and higher amount of Cu in female hair indicate at least a partial dependence of the concentrations of these elements on sex of the donor. Certain correlations among various members of family groups were also determined. (Diss. Abstr.)

23852 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR X-RAY ANALYSIS. Rhodes, John Rathbone (to United Kingdom Atomic Energy Authority). British Patent 1,065,918. Apr. 19, 1967. Filed Sept. 11, 1964.

A back-scatter geometry apparatus is provided for x-ray analysis that comprises a radioisotope source of x rays in a holder positioned so that primary radiation from the source strikes a generally concave target to produce secondary radiation from the target. A radiation measuring means with an external measuring surface extending partially around the perimeter of the target is provided, and means are provided to accommodate a shaped filter adjacent to the external radiation measuring surface. Shielding is provided to prevent the primary and secondary radiation from entering the measuring means directly. The source may consist of ^{241}Am or ^{109}Cd, and the target may be only one element or may be a mixture selected to give secondary x rays of two distinct energy components for the determination of two different elements present in the same sample. Suitable targets are Se, Cs, Sn, or mixtures of these. (B.L.M.)

23853 IMPROVEMENTS IN OR RELATING TO METHODS OF X-RAY ANALYSIS. Rhodes, John Rathbone (to United Kingdom Atomic Energy Authority). British Patent 1,065,919. Apr. 19, 1967. Filed Sept. 11, 1964.

A method of x-ray analysis for determination of a wanted element in a sample containing at least one interfering element comprises passing into the sample incident x rays made up of an analytical component and at least one compensating component. The energy band of each component of the x rays must be different from each other component. The analytical component has an energy band to give back scatter from or to excite fluorescence in the wanted element in the sample. Each compensating x-ray component has an energy band to excite fluorescence in one of the interfering elements. The total intensity of the x rays passing from the sample in a back-scattered direction is measured. The various components of the incident x rays are selected to give compensation for the matrix absorption effect. (B.L.M.)

23854 A METHOD FOR ANALYZING A GASEOUS MIXTURE AND APPARATUS FOR CARRYING OUT THIS METHOD. Fragneau, Guy (to CEA). British Patent 1,066,124. Apr. 19, 1967. Priority date May 21, 1964, France.

An apparatus for analyzing a gaseous mixture consists of a measuring vessel, means for causing the mixture to circulate in the vessel at such a pressure that it passes directly from the gaseous to the solid phase and inversely during temperature changes so as to trap a volume of the gas mixture in the vessel. A tank is arranged around the vessel with means for introducing a liquefied gas into the tank to cool it to a temperature lower than the sublimation temperature of all the components of the mixture whose concentration is to be measured. An apparatus is provided for recording variations in the pressure in the vessel during reheating. The method for using the apparatus to analyze mixtures is described. (B.L.M.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 23940 and 24067.

23855 (AEET-275) CATALYTIC EFFECT OF SOME IONS ON THE RATE OF THE REACTION BETWEN PLUTONIUM(III) AND CHLORINE IN CHLORIDE SOLUTIONS. Mazumdar, A. S. Ghosh; Gupta, B. L.; Natarajan, P. R. (Atomic Energy Establishment, Trombay (India)). 1967. 12p. Dep.

The catalytic effect of copper(II), chromium(III), manganese(II), iron(III), nickel(II), arsenic(III), cerium(III) and sulfate ions on the oxidation of plutonium(III) to plutonium(IV) by chlorine in hydrochloric acid solutions has been studied. It has been found that only cupric and ferric ions show a positive catalytic effect while none of the other ions seems to have any significant effect. (auth)

23856 (BM-IC-8317) THERMOPHYSICAL PROPERTIES OF SELECTED GASES BELOW 300°K. Guereca, Ross A.; Richardson, H. P.; Gordon, J. L.; Walker, J. D.; Cooper, J. L. (Bureau of Mines, Amarillo, Tex. Helium Research Center). July 1965. 226p. Bureau of Mines.

Data are presented on the general physical properties, viscosity, thermal conductivity, specific heat, compressibility, vapor pressure, density, dielectric constant, and refractive index for various gases including He, ^3He, Ne, Ar, Kr, Xe, H_2, D_2, N_2, O_2, CO, CO_2, CH_4, C_2H_6, and air. No specific property data are listed for Rn, although it is cross-indexed to allow for future expansion. Graphs are included to show trends and anomalies that may be obscure in tabular form. A total of 220 references are given. (P.C.H.)

23857 (CEA-R-3043) EXISTENCE ET STRUCTURE DES MONOCARBURES DE TERRES RARES. ETUDE DE LEURS PROPRIETES MAGNETIQUES A BASSES TEMPERATURES. (Existence and Structure of Rare-Earth Monocarbides: Study of Their Low-Temperature Magnetic Properties). Lallement, Robert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1966. 67p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

There are two types of rare earth carbides, the first one is fcc, stable at high temperature, and very hypostoichiometric (formula MC_x with $0.35 < x < 0.65$); the other is rhombohedric, stable at lower temperature, with a formula M_2C. These two carbides are magnetically ordered at low temperatures (ferro or ferri-magnetism). They are highly anisotropic. A great part of the electric and magnetic properties can be explained from the following ideas: the M^{3+} ions are coupled via the conduction electrons, there are more conduction electrons in the carbides than in the metals, and there is some local order around the transition temperatures. (auth)

23858 (CONF-661046) ABSTRACTS OF PAPERS TO BE READ AT THE INTERNATIONAL CONFERENCE ON HYPERFINE NUCLEAR SPECTROSCOPY IN WELLINGTON, NEW ZEALAND, OCTOBER 17-21, 1966. (Royal Society of New Zealand, Wellington). 42p. Dep. Royal Society of New Zealand, Wellington, 5/-d.

Topics covered include: Moessbauer spectroscopy, atomic and nuclear model calculations of spectroscopic properties, electron-nuclear interactions in compounds, isomer shifts, quadrupole splittings, nuclear magnetic resonance techniques, nuclear hyperfine couplings, crystal spectroscopy and intermolecular forces, electron spin resonance, nuclear orientation, magnetic hyperfine spectra, solid-state effects of nuclear transformations, and uses of Moessbauer effect in various studies. (M.C.G.)

23859 (EUR-3272.d) DIFFUSION VON SPALTPRODUKTEN BEI UEBERLAGERTER CHEMISCHER REAKTION. THERMODYNAMISCHE BERECHNUNGEN. (Diffusion of Fission Products in Overlapping Chemical Reaction. Thermodynamic Calculations). Laser, M.; Kirchner, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie). Nov. 29, 1966. 18p. (In German). (CONF-661049-1). Dep.

From Symposium on Reactor Chemistry, Juelich, Germany.

The experimental results published to date on the fission products diffusion in graphite show that in many cases the simple Fick law is not fulfilled. It is therefore suspected that a compound formation overlaps the pure diffusion. As scarcely any thermodynamic data are available for the calculation of such a compound formation, the heat-formation values for alkaline earth and lanthanide carbides were estimated by a Born-Haber cycle process. The vapor pressure over the carbides and consequently the fission product evaporation rate are to some extent appreciably below those for the corresponding metals. The diffusion through the

coating or in the graphite may also be dependent on the vapor pressure over the concentration gradient which is built up. It would further appear, for example, that in the case of porous graphite the mass transport of the fission products also takes place via the gas phase. The considerable differences found by others in the diffusion coefficient of, for instance, barium and strontium may be accounted for semi-quantitatively by the different vapor pressures. Effective decontamination of carbide fuel particles by evaporation of the most important neutron poisons at temperatures above 2000°C seems to be extremely tricky, since, while it is true that evaporation rates rise with temperature, the vapor-pressure curves for uranium and fission products tend to approach each other more and more. (auth)

23860 (LA-DC-8441) SHOCK TUBE STUDY OF THE EFFECTS OF NITROGEN AND WATER VAPOR ON RECOMBINATION IN THE HYDROGEN–OXYGEN SYSTEM. Getzinger, R. W.; Blair, L. S. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 15p. (CONF-670407-1). Dep. CFSTI.

From 6th International Shock Tube Symposium, Freiburg, Germany.

Shock tube studies were made on the effects of N_2 and H_2O vapor on recombination in the H_2-O_2 system in argon. The nitrogen experiments were made at 1518 to 1912°K and the water vapor experiments at 1259 to 1550°K. Nitrogen was found to be more efficient than argon in promoting the reactions between H_2 and O_2 by less than a factor of 2. Chemical reactions involving N_2 were too slow at the temperatures studied to have influenced the results much. It is believed that in an atmosphere containing 1% or more water vapor vibrational relaxation of N_2 can be assumed to have taken place before any significant amount of recombination has occurred. (P.C.H.)

23861 (ORO-2073-12) SURFACE TENSION, VISCOSITY, AND RAMAN SPECTRA OF FUSED SALTS. Final Report, June 1956–November 1966. Ellis, R. B. (Southern Research Inst., Birmingham, Ala.). Apr. 14, 1967. Contract AT(40-1)-2073. 36p. Dep. CFSTI.

Some physical properties of fused salts were measured, and the resulting data were interpreted in terms of the structure of the molten state. Surface tension, viscosity, and Raman spectroscopy were the principal areas of activity. Densities were measured as needed in the work on surface tension and viscosity. A minor effort was spent in the measurement of the interfacial tension between molten salts and molten metals. An empirical correlation between the surface tension of alkali metal and alkaline earth metal halides and some fundamental properties of the compounds was developed. The crystal lattice energy was used as a first approximation to the short-range forces acting between neighboring ions, with a modification based on the polarizability of the surface ions. This correlation helped to show up some discrepancies in existing data. The variations in surface tension of several mixtures of salts with composition and with temperature were studied. Most of this work was done on the reciprocal system K^+, Cd^{2+}/ Cl^-, Br^-. The results suggested the existence of complex ions in the surface, but it was not possible to identify them. Some work was done in the $ZnCl_2-KCl$ system, which indicated that $ZnCl_2$ was extensively associated at temperatures near the melting point. The nature of the associated species was identified by means of Raman spectroscopy. The viscosities of cadmium halide–potassium halide systems were also investigated in an attempt to gain more insight into the nature of possible complexes. Raman spectra of zinc halide melts not only identified the highly associated (polymerized) species in pure zinc halides but also established the presence of both tri-halo and tetra-halo complexes. The relative strengths of chloride, bromide, and iodide as ligands were demonstrated to be Cl < Br < I. (P.C.H.)

23862 (UCRL-17336) DISSOCIATION OF HYDROGEN ON TANTALUM USING MODULATED MOLECULAR BEAM TECHNIQUE. Krakowski, Robert A. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1967. Contract W-7405-eng-48. 290p. Dep. CFSTI.

Thesis.

The dissociation of molecular hydrogen on hot tantalum surfaces has been investigated with a high vacuum apparatus using a modulated molecular beam-mass spectrometric technique. A modulated beam of molecular hydrogen, formed by effusion from a high pressure source, impinged upon the tantalum target. The reflected H_2 and H atoms emitted after surface dissociation were monitored by a mass spectrometer in the vacuum system. The beams were modulated and the products measured by a phase-sensitive detector to improve the signal-to-noise characteristics of the detection system. The degree of dissociation was studied as a function of the surface temperature, beam temperature and beam intensity. Experimental results have been analyzed in terms of phenomenological first and second order kinetic models. Within the pressure (3×10^{-7} torr) and temperature (1000 to 2500°K) ranges studied, all data agreed best with the first order mechanism, and yielded 65 kcal/mole for the hydrogen/metal bond energy. At a given temperature, dissociation increased with the beam temperature with an apparent activation energy of 1.4 kcal/mole, which was independent of the surface temperature. The rate of dissociation varied linearly with the beam intensity. Mixed hydrogen/deuterium beams were employed to investigate the isotope exchange reaction, and, within the sensitivity of the detection system, exchange did not take place. A simple kinetic model, which proposes a high adatom recombination probability before significant surface diffusion occurs, was proposed to explain the observed first order kinetics. Also, hydrogen solubility in the metal bulk has been considered as a possible source for the observed non-equilibrium behavior. (auth)

23863 (UJV-1738) VYPAROVANI AKTINIDU A JEJICH SLOUCENIN. II. VYPAROVANI NEKTERYCH SLOUCENIN THORIA. (Vaporization of Actinides and Their Compounds. II. Vaporization of Some Thorium Compounds). Krivy, I. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1967. 23p. (In Czech). Dep.

The vaporization of some binary compounds of thorium, namely oxides, carbides, silicides, germanides, nitrides, phosphides, and sulfides is discussed. A survey and evaluation was made of all the available papers in the field up to the end of the past year, particular attention being paid to the compounds of interest in nuclear reactor technology, such as ThO_2 and ThC_2. For each two-component system (e.g., oxides, carbides etc.) a list of the binary compounds and their crystal structures is given, along with the composition of the vapor over the condensed phases (at least qualitatively) together with the dependence on the experimental conditions, and last, the results of tensimetric experiments usually given in the form $\log P = \varphi(T)$. The values of dissociation energy for the gaseous species or eventually those of standard free energy of formation for the individual condensed phases (ΔG_f^0) are presented provided that they are derived on the basis of tensimetric data. (27 references). (auth)

23864 (ANL-Trans-450) AN EXPERIMENTAL DETERMINATION OF THE ENTHALPY OF CORUNDUM (Al_2O_3) FROM 500 TO 2000°C. Kirillin, V. A.; Sheindlin, A. E.; Chekhovskoi, V. Ya. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Inzh.-Fiz. Zh., 4: No. 2, 3-17(1961). 19p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

An experimental setup is described for the investigation of enthalpy and heat capacity of solids to 2400°C. The setup operates by the mixing method with a massive metallic calorimeter. The calorimeter is graduated directly according to the resistance of two platinum resistance thermometers. In the process of graduation the questions of the effects of various forms of temperature curve of the main period on the results of the investigation, the limits of application of the law of cooling, and others are clarified. In the high temperature field the following problems are solved in a special manner protection of the calorimeter from heat radiation from the furnace, calculation of heat loss of a model entering the calorimeter, suspension of models in the furnace. Results of the investigation of enthalpy of corundum (α-modification of aluminium oxide) are tabulated. At temperatures of from 500 to 2000°C, 30 experimental points are obtained which are compared with data of others. (auth)

23865 ISOTOPE EFFECT IN SODIUM SELF-DIFFUSION. Barr, L. W.; Mundy, J. N. (Atomic Energy Research Establishment, Harwell, Eng.). pp 171-82 of Diffusion in Body-Centered Cubic Metals. Metals Park, Ohio, American Society for Metals, 1965. (AERE-R-5049).

The two isotopes of Na, ^{22}Na and ^{24}Na, having the largest mass difference of any radioisotopes readily available were used to measure the isotope effect in Na self-diffusion and in NaCl, and both isotopes were diffused simultaneously to eliminate as many errors as possible. The diffusion in NaCl was found to be by vacancies as previously postulated. The small isotope effect noted in Na metal almost rules out interstitial diffusion, but a split interstitial at the body center diffusing as an interstitialcy or as a relaxed vacancy are suggested as mechanisms of diffusion. (B.L.M.)

23866 ISOTOPIC-EXCHANGE INVESTIGATION ON SILICATE ION EXCHANGERS. IV. ON THE METHOD FOR DETERMINATION OF THE SELF-DIFFUSION COEFFICIENT BY HETEROGENEOUS ISOTOPIC EXCHANGE. Hoinkis, E.; Levi, H. W.; Lutze, W.; Miekeley, N.; Tamberg, T. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch., 22a: 220-5(Feb. 1967). (In German).

The evaluation of heterogeneous isotopic exchange processes between solid bodies and fluids with the help of diffusion equations,

especially the experimental provisions and the limits of the approximation method, is discussed. A method is given to evaluate exchange processes with cubical grains, whose edge lengths show a Gaussian distribution. Experimental methods for measuring heterogeneous exchange processes under various conditions are discussed. (tr-auth)

23867 ISOTOPIC-EXCHANGE INVESTIGATION ON SILICATE ION EXCHANGERS. V. THE KINETICS OF THE SELF-DIFFUSION OF ALKALI METAL IONS IN SYNTHETIC ZEOLITHS OF TYPE A. Hoinkis, E.; Levi, H. W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch., 22a: 226-32(Feb. 1967). (In German).

Self-diffusion processes in the Na, K, Rb, and Cs forms of synthetic Zeolith A were measured. The Na and K isotopic exchange proceeded extremely rapidly. For evaluation of Rb and Cs exchange a method suitable for cubes with normally distributed edge lengths was used. Neither exchange process is a homogeneous, ideal diffusion process. Nevertheless, they may be evaluated by the assumption that two different rapid diffusion processes, independent of one another, take place. The ratio of the slow division process to the total process decreased with increasing temperature. The activation energies of both division processes are almost the same, the D_0 values differ by about 2 orders of magnitude. The existence of two diffusion processes is ascribed to the fact that the exchangeable ions are present in the lattice of Zeolith A in two structurally unequal positions. (tr-auth)

23868 STUDIES ON HYDROGEN EXCHANGE. III. DEUTERIUM EXCHANGE OF CARBONYL COMPOUNDS IN ALKALINE MEDIA. Kawazoe, Yutaka; Ohnishi, Masako (National Cancer Center Research Inst., Tokyo). Chem. Pharm. Bull. (Tokyo), 14: 1413-18(1966).

Deuterium exchange of the hydrogens adjacent to carbonyl functions, such as in ketones, carboxylic acid, amides, and esters, in alkaline media was studied. The general features of D exchange of carbonyl compounds and a simple method for their quantitative analysis by the NMR technique are described. Comparisons were made on the D exchange reactivity of α-hydrogens of various ketones on the basis of data for gradual deuteration in very dilute sodium carbonate solutions, ranging from pH 7 to 8, at room temperature. Qualitative comparisons of the exchange rates were carried out by inspection of the NMR spectrum of the solution, which contained the 2 compounds to be compared. The order found for exchange reactivity was compatible with the concept that diethyl ketone was less reactive than acetone due to an electron-donating inductive effect of methyl groups, and that cyclopentanone was more active than cyclohexanone due to the smaller energy difference between cyclopentane and its dissociated carbanion than the difference for cyclohexane. A comparison was made of the reactivity of α-hydrogens of carboxylic acids. The hydrogens were much less reactive than those adjacent to the ketone's carbonyls. Sodium formate was quite stable under alkaline conditions. A considerable deactivating effect of methyl group in propionate on the exchange reactivity was seen as compared with acetate. On the other hand, substituents such as phenyl and halogens increased the reactivity markedly. Substituents on the amide nitrogen did not affect reactivity and 5- and 6-membered lactams had the same exchange reactivity as that of aliphatic amides. When they were treated in aqueous solution, deuteration did not occur in advance of hydrolysis. Various esters derived from propionic acid were also treated with 1M methanol solution of sodium methoxide but deuteration did not occur below 105°C. Acetonitrile underwent the D exchange gradually at room temperature, accompanied by hydrolysis. (BBB)

23869 OXIDATION OF RADON IN AQUEOUS SOLUTIONS. Haseltine, M. W.; Moser, H. C. (Kansas State Univ., Manhattan). J. Amer. Chem. Soc., 89: 2497-8(May 10, 1967).

Various aqueous, oxidizing solutions were allowed to remain in contact with 10^{-7}M $RaBr_2$ for 23 days or longer (six half lives of radon), after which they were extracted with equal amounts of hexane. The relative amounts of radon in the two phases were determined by counting the 0.35 MeV α activity of a subsequent daughter, ^{214}Pb. Results of ion exchange experiments indicated that oxidized radon in neutral or acidic solutions behaved as a polar but nonionic species. The oxidation of radon was accomplished only in solutions in which ^{222}Rn was allowed to come to secular equilibrium with ^{226}Ra. (J.G.B.)

23870 RETENTION OF CONFIGURATION IN THE SOLVOLYSIS OF 2,3-DIDEUTERIO-7-NORBORNYL p-BROMOBENZENESULFONATE. Miles, Frank B. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc., 89: 2488-9(May 10, 1967).

Deuterated p-bromobenzenesulfonate was solvolyzed for 90 min in acetic acid at 205°. The product, 7-norbornyl acetate, was isolated and purified by gas chromatography. Examination of the NMR spectrum of this acetate revealed that it consisted of 90 ± 5% anti acetate (retention of configuration) and 10 ± 5% syn acetate (inversion of configuration). Solvolysis of deuterated p-bromobenzenesulfonate for 16 hr in refluxing formic acid gave deuterated 7-norbornanol with 85 ± 5% retention of configuration. Classical and nonclassical ion hypotheses were considered as the explanation for the predominant retention of configuration in the solvolysis of deuterated p-bromobenzenesulfonate. It was concluded that further work must be done before a clear-cut choice can be made. (J.G.B.)

23871 IRREVERSIBLE HEAT OF TRANSITION OF ANHYDROUS URANIUM TETRAFLUORIDE. Khripin, L. A.; Khanaev, E. I. (Inst. of Organic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, (11), Ser. Khim. Nauk, No. 3, 139-41(1965). (In Russian).

Dehydration of rhombic $UF_4 \cdot 2.5\ H_2O$ at 225°C leads to an unstable form of anhydrous UF_4, which on further heating is converted at 270 to 370°C to a monoclinic stable form of UF_4 with the evolution of heat. The heat of hydration of the stable monoclinic form can be considered as the difference in the heat of hydration of the stable form of anhydrous UF_4 to the corresponding hydrate, and the irreversible heat of transition of the unstable form into the stable form. The transition heat was estimated by a thermographic method by comparison with heat of evolution in Na_2SO_4 at 220 to 240°C. It was determined that Na_2SO_4 did not react with UF_4. The transition heat of the freshly prepared, rhombic anhydrous form of UF_4 was found to be 5.8 kcal/mol at 25°C. The transition heats for the anhydrous, cubic form were 7.2 kcal/mol for the freshly prepared sample, and 5.2 kcal/mol for the aged sample. The transition heat of the monoclinic form was 0.9 kcal/mol for a freshly prepared sample. (TTT)

23872 KINETIC MECHANISM FOR THE CONTAMINATION OF A PRECIPITATE BY IMPURITIES. Nikolaev, A. V.; Sorokina, A. A.; Tsubanov, V. G. (Inst. of Organic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, (11), Ser. Khim. Nauk, No. 3, 94-8(1965). (In Russian).

The time of redissolution of a rare earth hydroxide (La, Pr, Y, and Ho) precipitated from solution by the dropwise addition of caustic or ammonia was determined in correlating the contamination of the precipitate. The rare earth nitrate solution contained 1.5 or 3.0% rare earth calculated as the oxide. The temperature (50°C), the volume, and rate of agitation were held constant. The initial pH of the solution was 0.9. Ammonia was added dropwise to the solution after dissolution of the previous precipitate. The time of dissolution was determined visually. The average time of dissolution after addition of one drop of ammonia to a 3.0% solution was 27 sec for La, 32.5 sec for Pr, 36.3 sec for Y and 47 sec for Ho. The corresponding times for a 1.5% rare earth solution were 16, 21.1, 36.5 and 35.4 sec. The addition of 20% NH_4NO_3 to the solution increased the average dissolution time of the precipitate. (TTT)

23873 OXYGEN EXCHANGE BETWEEN ReO_4^- AND H_2O. Hess, B.; Pieper, H. H.; Wiechen, A.; Schwochau, K. (Kernforschungsanlage, Juelich, Ger. Univ., Cologne). Z. Naturforsch., 21a: 2115(Dec. 1966). (In German).

The velocity of the oxygen exchange between ReO_4^- and H_2O enriched 8-fold in ^{18}O was measured as a function of the H^+ activity and the temperature. The exchange rate decreased sharply with increasing pH value. For measurements of the exchange rate as a function of the temperature between 10 and 75°C the activation energy of the exchange reaction was 8.1 kcal/mol for pH < 4. (J.S.R.)

23874 RATES AND ISOTOPE EFFECTS IN THE PROTON TRANSFERS FROM 2-NITROPROPANE TO PYRIDINE BASES. Lewis, Edward S.; Funderburk, Lance H. (Rice Univ., Houston, Tex.). J. Amer. Chem. Soc., 89: 2322-7(May 10, 1967).

The reactions between pyridine bases and 2-nitropropane in the presence of iodine was studied in t-butyl alcohol–water mixtures. In the absence of excess iodide ion and with only a small fraction of the pyridine converted to its conjugate acid, reversibility was found to be negligible, and the reaction was apparently free from solvent and lyate ion catalysis. Steric retardation from 2- and 6-alkyl groups in the pyridine was significant, and comparable in magnitude to the acceleration resulting from the increase in base strength. Isotope effects measured when using 2-nitropropane-2-d were large and variable, increasing not only with base strength but also with steric hindrance from a value of $k_H/k_D = 9.8$ at 24.88° for pyridine catalysis to $k_H/k_D = 24.2$ for 2,4,6-trimethylpyridine catalysis at the same temperature. Reasons for the unusually large isotope effects are considered; both tunneling and extensive loss of zero-point energy are invoked. (auth)

23875 CORRELATION BETWEEN SOLUBILITY AND THE EXTENT OF COMPLEXON SUBSTITUTION WHEN POORLY SOLUBLE COMPOUNDS ARE DISSOLVED IN COMPLEXON SO-

LUTIONS. Logvinenko, V. A.; Nikolaev, A. V.; Myachina, L. I. Dokl. Akad. Nauk SSSR, 170: 883-5(Oct. 1, 1966). (In Russian).

In view of difficulties caused by the formation of substituted complexes in solubility measurements, an attempt was made to establish a simple correlation between the solubility and any parameter not affected by the composition changes of the complex. Data indicated that the solubility of a number of compounds is linearly dependent on the degree of substitution of the involved complexon (acid) or the $NaOH/H_4T = z$ ratio in the complexon, whereby (H_4T is the complexon) in the $2 < z < 4$ range, at pH values between 4 and 8. The solubility of La, Ce, and Ca oxalates and of U fluoride was investigated in alkaline solutions of EDTA (ethylenediaminetetraacetic acid) (H_4T) and Complexon(IV) (H_4R) at 25 ± 0.1°C. The solubility of these compounds was found to be controlled by the degree of substitution of these complexes. The dependence of the solubility on the degree of solubility z in the concentration range from $C_T = 0.100$ to 0.286 mole/liter was found to follow the expression $a = [0.245 \cdot (z - 2) + 0.01] \cdot C_T$. The three-dimensional surface with coordinate axes of a, C_T, and z corresponding to this equation is close to a hyperbolic parabola. (TTT)

23876 STUDY OF THE REACTION BETWEEN METALS AND MOLTEN SALTS. Kamegashira, Naoki; Hama, Yoshiko (Osaka Univ.). Technol. Rep. Osaka Univ., 16: 663-70(Oct. 1966).

A study was carried out in order to clarify the interaction between metals and molten salts. Results of thermal analyses and electric conductivities of a salt-rich solution of Sn in molten $BiCl_3$ are included as one of the basic researches on mixtures of metals with molten salts. For this system, when Sn is dissolved in molten $BiCl_3$, the reaction is expected to proceed by $3Sn + 2BiCl_3 \rightarrow 3SnCl_2 + 2Bi$. Bi produced dissolves in molten $BiCl_3$. To make these relations clear the thermal analyses were taken and for the monophase regions, about 20 mole % metal, which were found by them, the electric conductivities were measured by means of the capillary cell method over a range of temperatures from 240 to 400°C under argon atmosphere. These results were compared with those for the Bi–$BiCl_3$ system, and it was found that at lower metal concentrations the conductivity of the Sn–$BiCl_3$ system was similar to that of higher temperature side of the Bi–$BiCl_3$ system. (auth)

23877 THE FORMATION OF A NEPTUNIUM(V)–RHODIUM(III) COMPLEX. KINETICS AND EQUILIBRIA IN ACIDIC SOLUTIONS. Murmann, R. Kent; Sullivan, James C. (Argonne National Lab., Ill, Univ. of Missouri, Columbia). Inorg. Chem., 6: 892-900(May 1967).

A Np(V)–Rh(III) complex was prepared and separated from the reaction mixture, and the absorption spectrum characterized. A value for the equilibrium quotient $Q = [Np(V)-Rh(III)]/[Np(V)][Rh(III)]$ of 3.31 ± 0.06 M^{-1} at 25°C was determined spectrophotometrically. Values of $\Delta H = -3.6 \pm 0.9$ kcal $mole^{-1}$ and $\Delta S = -10 \pm 3$ eu were determined. The rate of approach to equilibrium and the rate of dissociation were measured. The HF-catalyzed rates of dissociation of the Np(V)–Rh(III) and Np(V)–Cr(III) complexes are compared. A kinetic study of the exchange between the aquated ions Cr(III), Rh(III), and Np(V) and ^{18}O-labeled solvent water was carried out with and without added HF. Rates of approach to equilibrium between Np(V) and $[Cr(H_2O)_5Cl]^+$ and $[Co(en)_2(OH_2)_2]^{3+}$ are reported. (auth)

23878 COMPLEX METAL COMPOUNDS WITH NITROGEN CONTAINING LIGANDS. V. ZIRCONIUM, HAFNIUM, AND THORIUM COMPLEXES WITH IMIDAZOLE AND ITS DERIVATIVES. Panyushkin, V. T.; Garnovskii, A. D.; Osipov, O. A.; Sinyavin, A. L.; Pozharskii, A. F. (Rostov State Univ., Rostov-on-Don, USSR). Zh. Obshch. Khim., 37: 312-17(Feb. 1967). (In Russian).

Studies were made of Zr, Hf, and Th complexes with imidazole and its derivatives. Spectroscopic characteristics of the complex compounds, basic ligand constants, and stability constants were correlated with the ratio of metal and chlorine covalent radii. (R.V.J.)

23879 SLOW PROTON TRANSFER IN THE NITRATION OF ANTHRACENE; DETERMINATION OF THE KINETIC ISOTOPE EFFECT OF HYDROGEN IN THE NITRATION OF NAPHTHALENE AND ANTHRACENE WITH NITRONIUM TETRAFLUOROBORATE. Cerfontain, H.; Telder, A. (Univ., Amsterdam). Rec. Trav. Chim., 86: 371-80(Apr. 1967).

The kinetic isotope effect of hydrogen in the nitration of anthracene with nitronium tetrafluoroborate was determined, using anthracene-9-d as substrate. In solfolane as solvent at 30°C and in acetonitrile at 0°C, k_H/k_D was found to be equal to 2.6 ± 0.3 and 6.1 ± 0.6, respectively. The kinetic isotope effect of hydrogen in the nitration of naphthalene in these two solvents under similar reaction conditions, using naphthalene-1,4-d_2 as substrate, were found to be 1.15 ± 0.05 and 1.08 ± 0.05, respectively. UV spectral evidence showed that the nitration of anthracene with nitronium tetrafluoroborate in sulfolane as solvent proceeds via an intermediate, which is suggested to be the 9-nitro-9-anthracenonium ion. This intermediate is formed directly on mixing the reagents. The proton transfer from this intermediate with formation of 9-nitroanthracene is a relatively slow process. (auth)

23880 ISOTOPIC EXCHANGE OF BROMIDE LIGANDS IN PLATINUM(II) COMPLEXES. THE BROMO(DIETHYLENETRIAMINE)PLATINUM(II)–TETRABROMOPLATINATE(II)–BROMIDE SYSTEMS. Teggins, John E.; Martin, Don S. Jr. (Ames Lab., Iowa). Contract W-7405-eng-42. Inorg. Chem., 6: 1003-7(May 1967). (IS-1436).

The exchange rate of $Pt(dien)Br^+$ with Br^- was found to follow the rate law: $R_{ex} = \{k_1 + k_2[Br^-]\}\ [Pt(dien)Br^+]$. The addition of $PtBr_4^{2-}$ to the $Pt(dien)Br^+ - Br^-$ solution was shown to result in an increase in the exchange rate of both $Pt(dien)Br^+$ and $PtBr_4^{2-}$ by equal amounts. This mutually catalyzed exchange process is described by the expression: $R_{excess} = k_3[Pt(dien)Br^+]\ [PtBr_4^{2-}]$. (auth)

23881 ISOTOPIC EXCHANGE OF IODINE DERIVATIVES OF THE ORTHO- AND META-BARENE OF THE ORTHO- AND META-DICARBADODECARBORANES WITH $Na^{131}I$. Stanko, V. I.; Gol'tyapin, Yu. V.; Volkov, A. F. Zh. Obshch. Khim., 37: 514 (Feb. 1967). (In Russian).

It was found that a 3-hr isotopic exchange between 12-iodo-o-barene; 10-iodo-m-barene; 10,12-o-diiodo-o-barene; and 9,10-diiodo-m-barene with a carrier-free $Na^{131}I$ takes place in trihexyl phosphate solutions. Exchange between 12-iodo-o-barene and 10-iodo-m-barene reached to to 70%; with diiodo-o- and -m-barenes the isotopic exchange reached 20 to 30%. These percentages were determined by paper electrophoresis and autoradiography. (R.V.J.)

23882 USE OF TRITIUM IN BIOCHEMISTRY. Simon, H. (Technische Hochschule, Munich). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Chem., Geol. Biol., No. 4, 273-82(1963). (In German).

If the splitting of a compound in a reaction depends on a single step that determines the reaction velocity and one of the components is replaced by a heavier isotope, the reaction is slowed. Studies that involve the use of ^3H are markedly affected by this sort of isotope effect (IE). This is illustrated by a reaction where a methyl group labeled with ^3H is split apart. Comparison of the relative reaction velocity constants for removal of H or ^3H from the group yields the kinetic or intermolecular IE, the intramolecular IE, and the secondary IE. In the case of ^3H, the C–H bond is frequently split 10 to 25 times faster than the C–^3H bond. Thus, the intermolecular IE has a value of ~1.6. Frequently the intramolecular IE is decreased and the secondary IE is increased, as compared to the unlabeled grouping. Since the mass difference between H and ^2H is smaller than the mass difference between H and ^3H, the IE for ^2H is smaller. As a general rule these differ by a factor of ~1.44. Although usually the compound with the heavier isotope reacts more slowly, sometimes the inverse is true and compounds with heavy isotopes may react more rapidly than normal. In general, ^3H-labeled compounds used in biochemistry show no IE. However, this effect may help to clarify certain mechanisms of enzyme reactions, such as dehydration of succinic acid with succinic dehydrogenase, where the breaking of the C–H bond is the rate-determining step for the entire reaction. (BBB)

23883 ELECTROCHEMICAL TECHNOLOGY IN MOLTEN SALTS. Inman, D. (Imperial Coll. of Science and Tech., London). Chem. Eng. (London), No. 206, CE51-4(Mar. 1967).

The subject is reviewed under the following headings: introduction; electrochemical principles; recent developments and future applications in molten salts (electro-winning, electro-refining, electro-cladding and electro-forming, miscellaneous deposition processes, electro-synthesis in molten salts); electrolysis and subsequent reaction with electrode material; electrolysis and subsequent reaction at inert electrodes; preparation of ions with unusual valency states; hydrogenation, and electroslag remelting process. Under "miscellaneous deposition processes" the preparation of single crystals of UO_2 by electrolysis of solutions of UO_2Cl_2 in a molten alkali metal chloride solvent is mentioned. The UO_2/UO_2^{2+} electrode reaction is quite reversible. It is pointed out that experimental problems are formidable in some cases, particularly with the use of very corrosive melts such as fluorides, and with high melting oxy-anionic materials such as silicates. Such problems can, however, be overcome, as for instance in the ORNL molten fluoride reactor. (UK)

23884 SOME ETHOXIDE COMPOUNDS OF NEPTUNIUM. Samulski, E. T.; Karraker, D. G. (E. I. du Pont de Nemours and Co., Aiken, S. C.). J. Inorg. Nucl. Chem., 29: 993-6(Apr. 1967). (DP-MS-66-59).

The preparation of $Np(OCH_3)_4$ and $Np(OC_2H_5)_4$ by the reaction of $NpCl_4$ and LiOR is reported. Attempts to oxidize $Np(OC_2H_5)_4$ with bromine produced two ethoxide derivatives, $NpBr(OC_2H_5)_3$ and $NpBr_2(OC_2H_5)_2$. Oxidation of $Np(OC_2H_5)_4$ to $NpBr(OC_2H_5)_4$ was suc-

cessful in the presence of $NaOC_2H_5$, but attempts to produce $Np(OC_2H_5)_5$ failed. These results are interpreted as indicating that the stability of Np(V) alkoxides is low and that Np(VI) alkoxides may not exist. (auth)

23885 FAST REACTIONS IN THE SHOCK TUBE. Borrell, Peter (Univ. of Keele, Eng.). Bild. Wiss., 3: 654-64(Aug. 1966). (In German).

Principles of the use of shock tubes in the study of fast chemical reactions are reviewed. The construction of a shock tube is outlined, and the nature of the information obtained from such a device is explained. In particular, a number of chain reactions are discussed, among them the reaction of D_2 and NH_3 to produce NH_2D and HD at 1200°C. Demonstrations of dilution techniques are illustrated in this example by the inclusion of Ar. Reaction occurs when D_2 is in the fifth vibrational quantum level, at which point the mean bond length in the D_2 molecule is equivalent to that of the N–H bond length in ammonia. (BBB)

23886 SORPTION OF CARBON MONOXIDE BY POLYCRYSTALLINE MOLYBDENUM. Degras, Denis A. (CEN, Saclay, France). J. Chim. Phys., 64: 405-11(Mar. 1967). (In French).

The heats of chemisorption of carbon monoxide on a polycrystalline molybdenum surface were investigated by flash thermal desorption. Three chemisorbed states were found which correspond respectively to 0.88, 1.82, and 2.85 eV binding energy. A weak reversible adsorption was also found, the binding energy of which is 0.20 eV. Frequency factors of the chemisorbed states are consistent with the Cremer–Constable compensation effect for which the deduced isokinetic temperature is 1.890°K The sticking cross section of CO on Mo is 1.4×10^{-15} cm^2. (auth)

23887 OXYGEN EXCHANGE BETWEEN CARBONATE AND BICARBONATE IONS AND WATER. I. EXCHANGE IN THE ABSENCE OF ADDED CATALYSTS. Poulton, D. J.; Baldwin, H. W. (Univ. of Western Ontario, London). Can. J. Chem., 45: 1045-50(May 15, 1967).

The reaction of carbon dioxide with water and hydroxide ions was studied by measuring the rate of oxygen exchange between sodium carbonate and bicarbonate and ^{18}O-enriched water as a function of pH, ionic strength, and carbonate-bicarbonate concentration. It was shown that these reactions are catalyzed by carbonate and bicarbonate ions. Rate constants for the uncatalyzed and catalyzed reactions were evaluated. (auth)

23888 ISOTOPE EFFECTS IN ISOTOPIC EXCHANGE REACTIONS WITH VARIOUS IODIDE ISOTOPES. Elias, H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 6: 210-13(Dec. 1966). (In German).

The bimolecular isotope exchange $ICH_2{}^*I + I^- \xrightarrow{\tilde{k}} CH_2I_2 + {}^*I^-$ was investigated in dimethyl formamide at a temperature of 19.9°C with $^*I = {}^{131}I$ and $^*I = {}^{128}I$. For the ratio of the rate constants a value of $\tilde{k}_{131}/\tilde{k}_{128} = 1.023 \pm 0.010$ was determined. (auth)

23889 THE CRYSTAL STRUCTURES OF TUNGSTEN, MOLYBDENUM, RHENIUM, AND TECHNETIUM OXIDE TETRAFLUORIDES. Edwards, A. J.; Jones, G. R.; Steventon, B. R. (Univ. of Birmingham, Eng.). Chem. Commun., No. 9, 462-3 (1967).

The detailed molecular structure of $MoOF_4$ was determined from three-dimensional data, using MoKα radiation. There are eight $MoOF_4$ units in the cell. Atom positions were determined by the usual "heavy atom" methods and the atomic parameters refined by full-matrix least-squares cycles. The structure consists of distorted octahedral groups, linked into endless chains parallel to the c-axis by cis-bridging atoms. Although $ReOF_4$ has very different unit cell dimensions, the molecular structural unit is very similar, with chains parallel to the b-axis. $TcOF_4$ was shown to also have this structural unit. The structural units for $MoOF_4$ and $ReOF_4$ consist of two crystallographically distinct octahedra, in which the bond lengths and angles are very similar. The most significant feature of the structure is the single, very short, terminal bond length of 1.65 Å in each octahedron, which it is suggested is due to a multiple bond to oxygen. Some data are given on the infrared spectra of $MoOF_4$ and WOF_4 in the vapour phase, suggesting a simple monomeric structure. Full crystallographic data are tabulated for the four compounds, and models shown for the $MoOF_4$ and $ReOF_4$ structures. (UK)

23890 MEASUREMENTS AND CALCULATIONS OF ABSOLUTE INFRARED INTENSITIES IN SOLUTION. NOTE II. H_2O, D_2O. Scrocco, Marisa; De Luca, Bruno (Univ., Rome. CNR, Rome). Ric. Sci., 37: 24-32(Jan. 1967). (In Italian).

The absolute ir intensities of fundamental bands of H_2O and D_2O were measured in some solvents and the μ and $\partial\mu/\partial r$ of the solutions and gas phases were calculated using, in each case, to calculate the transforming matrix L^{-1}, the appropriate potential function obtained from the harmonic frequencies. The values obtained are compared. (auth)

23891 METHOD FOR MOUNTING POWDERED THERMOLUMINESCENT SAMPLES WITH IMPROVED THERMAL CONTACT. Nash, A. E.; Gorbics, S. G.; Attix, F. H. (Naval Research Lab., Washington, D. C.). Rev. Sci. Instrum., 38: 696-7 (May 1967).

The use of a pure gold matrix to bond thermoluminescent samples to a heat source and a temperature sensor in order to study the thermoluminescence of powders is discussed. (B.G.D.)

23892 SOLUBILITY ISOTHERMS FOR $Th(NO_3)_4$–HNO_3–H_2O AND $UO_2(NO_3)_2$–$Th(NO_3)_4$–HNO_3–H_2O SYSTEMS AT 25°C. Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk, No. 3, 129-31(1966). (In Russian).

The solubility isotherms of $Th(NO_3)_4$–HNO_3–H_2O and $UO_2(NO_3)_2$–$Th(NO_3)_4$–HNO_3–H_2O systems were investigated. Under given conditions the tetrahydrates of thorium nitrate and uranyl nitrate existed as solid phases in equilibrium with the liquid phase. Thorium nitrate tetrahydrate was crystallized from warm solution and the uranyl nitrate tetrahydrate was crystallized during partial dehydration of the hexahydrate of the uranyl nitrate with thorium nitrate. (tr-auth)

23893 STRUCTURE OF FLUORIDE-TYPE SOLID SOLUTIONS IN CERIUM–OXYGEN SYSTEM. Kuznetsov, F. A.; Chusova, T. P.; Ayupov, B. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk, No. 3, 126-9(1966). (In Russian).

An unusually high mobility of the solid solution was detected in the cerium–oxygen system with fluoride-type structure and CeO_2 to $CeO_{1.67}$ composition. The entropy of the solid solution resulting from possible models of their real structure was calculated. The model with indistinguishable cations and nonlocalization of the electrons agrees well with results of the thermodynamic calculation and explains the kinetic behavior of the solid solutions of CeO_x. (tr-auth)

23894 THE CHEMISTRY OF PROTACTINIUM. III. A STUDY OF THE SULFATE COMPLEX OF PROTACTINIUM(V) BY THE SOLVENT EXTRACTION TECHNIQUE USING TTA AS THE CHELATING AGENT. Mitsuji, Toshikazu; Suzuki, Shin (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap., 40: 821-6(Apr. 1967).

The behavior of pentavalent protactinium in sulfuric acid solutions was investigated by paper electrophoresis and by the TTA–benzene extraction method. Results indicated that the $Pa(OH)_2(SO_4)^+$ ion exists predominantly in dilute sulfuric acid solutions (pH 0.4 to 2.2), and that the complexing reaction of pentavalent protactinium by the sulfate ion may proceed as: $Pa(OH)_4^+ + 2H^+ + SO_4^{2-} \rightleftharpoons Pa(OH)_2(SO_4)^+ + 2H_2O$. The stability constant of $Pa(OH)_2(SO_4)^+$ was also determined by the solvent extraction method to be 6.4 at an ionic strength of 1.38. (auth)

23895 STUDIES OF THE COMPLEX FORMATION BETWEEN URANIUM AND THIOSALICYLIC ACID. Kumar, A. N.; Nigam, H. L.; Katyal, M. (Univ. of Allahabad, India). Bull. Chem. Soc. Jap., 40: 788-90(Apr. 1967).

Orange-yellow complexes formed by the interaction of uranium and thiosalicylic acid in 40% ethanol were investigated by spectrophotometric, potentiometric, and magnetic susceptibility measurements. Spectrophotometric studies revealed that a 1 : 1 complex was mainly formed below pH 4.5, while at higher pH's (5.5) a 1 : 2 (metal : ligand) complex was mainly formed. Magnetic susceptibility measurements pointed towards the diamagnetic character of the complexes. The stereochemical configuration of the complex ions is discussed. (auth)

23896 SOME REMARKS ON THE STRUCTURE OF H AND OH RADICALS IN AQUEOUS SOLUTIONS. Stolarczyk, L. (Inst. of Nuclear Research, Warsaw). pp 111-14 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Eight papers dealing with the structure of H and OH radicals in aqueous solutions are reviewed briefly. Some reactions are reviewed that illustrate the reaction mechanisms for the different proposed species. The rate constants for some reactions are given, as well as the values for the rate constants for the reactions of hydrated electrons with water and H_3O^+. (B.L.M.)

23897 DYE SENSITIZED PHOTOPOLYMERIZATION IN THE SOLID STATE. Barkalov, I. M.; Benderskii, V. A.; Goldanskii, V. I.; Kuzmina, S. S. (Inst. of Chemical Physics, Moscow). pp 607-12 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effects of addition of the dyes, riboflavine, methylene blue, and malachite green, on the photopolymerization of acrylamide and methacrylamide are discussed. Polymerization kinetics were found

to be independent of the dye concentration between 10^{-8} and 10^{-5} M. It was concluded that photochemical destruction of the dye cannot be responsible for the initiation of polymerization, and that the effect of the dye cannot be explained by photochemical destruction resulting in the release of ions and radicals that may react with the monomers to form active centers. It is necessary to assume a multiple excitation of the dye molecules leading to an energy transfer to appropriate centers in the initial substance. Since the energy required for electron excitation of the monomer molecules is higher than that of light, the active centers for solid-phase polymerization are concluded to be structural defects, which act as deep energy traps. The accumulation of energy by these "active" traps takes place not only in photosensitized polymerization but also under radiation and mechanical actions. A detailed consideration of the mechanism of solid-state polymerization is presented from the aspects of these traps. (B.L.M.)

23898 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF URANYL FLUORIDE. Grant, Albert Edgar (to United Kingdom Atomic Energy Authority). British Patent 1,063,801. Mar. 30, 1967. Filed Jan. 10, 1964.

A process for the production of uranyl fluoride comprises precipitating the uranyl fluoride from a solution of UF_6 in anhydrous HF by means of water and separating the precipitate from the mother liquor. Preferably, the water that is used for precipitation is mixed with HF in azeotropic proportions. The mother liquor is recycled after separation of the precipitate for the dissolution of further quantities of UF_6. The precipitated crystals of uranyl fluoride so prepared may be passed directly to a reduction kiln or fluidized bed for the production of UO_2 without prior removal of the last traces of HF that remain. (B.L.M.)

23899 PROCESS FOR THE MANUFACTURE OF ZIRCONIUM COMPOUNDS, ESPECIALLY ZIRCONIUM OXIDE. Meyer-Simon, E.; Frey, A. (to Deutsche Gold-und Silber-Scheideanstalt vormals Roessler). Canadian Patent 753,168. Feb. 21, 1967. Priority date Oct. 26, 1961, Germany.

A process for producing basic zirconium sulfate from which the oxide may be obtained on heating, is described. Zirconium silicate is treated with a specified mixture of hydrochloric and sulfuric acids. Silica may then be filtered off completely. Neutralization of excess acid yields basic zirconium sulfate of specific grain distribution for calcining to the pure dioxide. (F.S.A.)

23900 KINETICS OF AROMATIC HYDROGEN EXCHANGE IN CONCENTRATED AQUEOUS ACIDS. Vitullo, Victor Patrick. Chicago, Illinois Inst. of Tech., 1965. 120p.

Thesis.

Rates of exchange of 1,3,5-trimethoxybenzene-2-t (TMB-2-t), 1,3,5-triethoxybenzene-2-t (TEB-2-t), and 1,3,5-trihydroxybenzene-2-t (THB-2-t), were measured as a function of perchloric acid concentration from 1 to 3M. The first order rate constants can be fitted to an expression of the type $\log k = a(-H_0) + b$ where H_0 is the Hammett acidity function. The slopes (a values) were different for all three substrates: for TMB-2-t and TEB-2-t, a is 1.08 ± 0.01 and 0.96 ± 0.03, respectively, while a has the value 0.79 ± 0.01 for THB-2-t. These data were rationalized by assuming that the transition state for exchange in trihydroxybenzene is more highly solvated compared with its trialkyl ethers. A similar trend in slopes was observed previously for equilibrium aromatic protonation. An expression was derived, which allows a comparison of the equilibrium and kinetic protonation data. A parameter α can be evaluated, which measures the degree of resemblance of the protonation transition state of the carbon conjugate acid. α for TMB, TEB, and THB was 0.49 ± 0.01, 0.44 ± 0.01, and 0.48 ± 0.03, respectively. Rates of loss of tritium from 2,6-dimethoxytoluene-3-t (DMT-3-t) and 2,6-dihydroxytoluene-3-t (DHT-3-t) to aqueous $HClO_4$ and H_2SO_4 from 1 to 7M were studied. In $HClO_4$, $\log k_{obs}$ for 2,6-dihydroxytoluene was not linear in $-H_0$; the slope ranged from 1.10 at $H_0 = 0$ to 0.69 at $H_0 = -3$. For 2,6-dimethoxytoluene-3-t plots of $\log k_{obs}$ vs $-H_0$ were linear with slopes of 0.950 ± 0.009 (DHT-3-t) and 1.205 ± 0.009 (DMT-3-t). In both acids, plots of $\log k_{obs}$ vs $-H_0$ exhibited shallower slopes for DHT-3-t than for DMT-3-t. The acidity α values determined for DHT and DMT in $HClO_4$ were 0.66 ± 0.01 and 0.61 ± 0.01, respectively. Rates of exchange for DMT-3-t and DHT-3-t were found to be faster in H_2SO_4 than in $HClO_4$ when compared to the same H_0. For DMT $k_{H_2SO_4}/k_{HClO_4}$ ranged from 1.3 to 1.7 while $k_{H_2SO_4}/k_{HClO_4}$ ranged from 1.3 to 2.5 for DHT. Activation parameters for DMT-3-t in $HClO_4$ and in H_2SO_4 were measured and an attempt was made to explain these data in terms of H_2SO_4 catalysis. The tritium factor, ϕ_T, for a C–H bond in 1,3,5-trimethoxybenzene and O–H bond in H_2O was measured. ϕ_T is 0.923 ± 0.024. The secondary solvent isotope effect on proton transfer from the hydronium ion to 1,3,5-trimethoxybenzene can be evaluated from these data. The value thus obtained was 0.60 ± 0.02. This is the same as that reported earlier for 1,3-dimethoxybenzene. (Diss. Abstr.)

23901 ISOTOPE EFFECT IN THE TRANSPORT OF GASES THROUGH POLYMER MEMBRANES. Ziegel, Kenneth David. Brooklyn, Polytechnic Inst. of Brooklyn, 1966. 233p.

Thesis.

The transport rates of H and D were measured in five polymeric materials as a function of temperature and pressure to obtain information on the nature of polymer structure and free volume and also on the interactions between gaseous penetrants and polymer matrices. The average volume of the void spaces, or "holes," was measured and the volume distribution estimated on the basis of a recent quantum mechanical treatment of diffusion, suggested by H. L. Frisch, which predicts the void size in a polymer from differences between the activation energy of diffusion for H and the activation energy of diffusion for D. The diffusion coefficient, D, and the steady-state rate of permeation, P, were found by the method of time lag measurements in which the polymer film acts as a separating membrane between a high-pressure compartment and a vacuum chamber of known volume. A third quantity, the solubility coefficient, S, is derived from the relation: $S = P/D$. Transport measurements were obtained over a temperature range of at least 36°C and at various levels of gas inlet pressure using H and D as penetrants. Data treatment and statistical analysis were accomplished by the method of least squares using a computer program TMLG12 written in FORTRAN IV. For the three polymers for which a complete inlet pressure range could be examined, variations of diffusion and solubility with pressure were observed. The activation energies for diffusion, E_D, and the heats of solution, ΔH_s, were also found to be pressure-dependent. The isotope effect defined by Frisch's theory was found experimentally in all polymers studied and was interpreted in terms of the incremental free volume of the polymers. Two of the polymers were tested above and below their glass transition points. In each case, an abrupt change in the slope of the Arrhenius plot for diffusion was observed within a few degrees of the reported value of T_g. The transition was also found to influence the isotope effect, indicating that the incremental free volume is larger below T_g than above it. The results are discussed in terms of the various diffusion theories and with respect to concepts of polymer structure. The values of free volume obtained were used to derive theoretically based estimates of the diffusion parameters: the jump distance, λ, and ΔS^*, the entropy of activation for the diffusion process. (Diss. Abstr.)

23902 ELECTROCHEMICAL CHARACTERISTICS OF RARE EARTH AND YTTRIUM METALS IN PHOSPHORIC ACID. Morse, Stephen Lewis. Troy, N. Y., Rensselaer Polytechnic Inst., 1964. 51p.

Thesis.

Anodic and cathodic polarization measurements were conducted on twelve rare earth and Y metals in H_3PO_4 solutions. An analysis of the shape of the polarization curves is presented. Considerable deviation from Tafel behavior for cathodic measurements is predicted at low overvoltages due to the metal dissolution reaction of the system, and at high overvoltages to concentration and resistance effects. A method for calculating the electrochemical parameters of the system is presented. Corrosion potentials, Tafel slopes, hydrogen exchange currents, and corrosion currents for all thirteen metals are tabulated. It is emphasized that true parameters for the anodic and cathodic curves can only be determined if both curves are analyzed simultaneously. Exchange current densities for hydrogen reduction are correlated with the physical properties of those metals which exhibit similar Tafel slopes. (Diss. Abstr.)

23903 IMPROVEMENTS IN OR RELATING TO FOAM DEIONIZATION APPARATUS. Banfield, David Leslie; Newson, Ivan Henry (to United Kingdom Atomic Energy Authority). British Patent 1,062,346. Mar. 22, 1967. Filed Feb. 18, 1965.

A foam deionization process comprises introducing a solution to be treated into a first stage of the process, passing a partially deionized solution from the first stage to the last stage of the process, withdrawing a treated solution from the last stage, passing a gas into the solution in the last stage to cause bubbling and the formation of the foam, withdrawing some foam from the last stage and passing it to the first stage to cause foaming there. The foam can be withdrawn from the first stage and contains a high concentration of the ions initially present in the solution being deionized. One or more intermediate stages may be interposed into the process. The apparatus for carrying out the process is described in detail. (B.L.M.)

23904 METAL CHELATES OF TRIETHYLENETETRAMINEHEXAACETIC ACID AND TETRAETHYLENEPENTAMINEHEPTAACETIC ACID. Bohigian, Theodore Ara Jr. Chicago, Illinois Inst. of Tech., 1966. 127p.

Thesis.

A quantitative study of the chelating tendencies of triethylenetetraminehexaacetic acid (TTHA) and tetraethylenepentamineheptaacetic acid (TPHA) with representative metal ions of +2, +3,

and +4 charge was carried out in aqueous solution. The metal ions used were Ca(II), Mg(II), Cu(II), Co(II), Ni(II), La(III), Nd(III), and Th(IV). Metal chelate formation constants were determined from potentiometric equilibrium data obtained at 25°C and at an ionic strength of 0.1M in KNO_3. Interaction between equimolar quantities of TTHA and the alkaline earth metal ions resulted in the formation of diprotonated, monoprotonated, and mononuclear chelates. Combination of these metal ions with TTHA in 2:1 and 3:1 molar ratios of metal ion to ligand revealed formation of binuclear and ternuclear chelates, respectively. Formation constants were determined and possible structures proposed for all these species. Interaction between equivalent quantities of TTHA and transition metal ions (copper (II), cobalt (II), and nickel (II)) resulted in the formation of tetra-, tri-, di-, and monoprotonated chelates in addition to the mononuclear deprotonated species. Binuclear chelates were formed when two moles of the transition metal ions were combined with one mole of TTHA. Formation constants were calculated for these species. Lanthanum (III) and thorium (IV) formed very stable mononuclear chelates with TTHA, and lanthanum (III) also formed a rather weak binuclear chelate when the metal ion and ligand were combined in a 2:1 molar ratio. The formation constants for the La(III) chelates were calculated and the Th(IV)–TTHA constant was estimated. Evidence is presented supporting a heptacoordinated structure for the mononuclear lanthanum (III)–TTHA chelate and a coordination number of ten for thorium (IV). Stable binuclear mixed ligand chelates in which each of the two metal ions is combined to two different ligands one of which is common to both metal ions were formed upon addition of two moles of a bidentate ligand to binuclear Cu(II) and Fe(III) chelates of TTHA. Appropriate formation constants were determined for these systems. Thus an alternative to hydrolysis, olation, or disproportionation of incompletely coordinated binuclear transition metal chelates of TTHA was provided. The results obtained for tetraethylenepentamineheptaacetic acid chelates indicated that this ligand may represent the leveling-off point in the homologous series of Formula I beyond which further increase in the number of donor groups may not produce an increase in metal chelate stability. (Dissertation Abstr.)

23905 DEUTERIUM ISOTOPE STUDIES ON SELECTED PESTICIDES AND SYNERGISTS. Whalen, Richard William. New York, Fordham Univ., 1966. 196p.

Thesis.

The difference in zero point energy of C–H and C–D bonds leads to a difference in rates of reactions in which these bonds are broken. An effect of deuteration at strategically important positions on the action of selected pesticides and synergists was sought in comparative in vivo and in vitro tests. Chlorination of benzene-d_6 yielded chlorobenzene-d_5, two moles of which were condensed with chloral or chloral-d to yield either DDT-d_8 or DDT-d_9. Toxicity studies on DDT-resistant Aedes aegypti larvae showed that deuteration of the aromatic ring did not affect the lethality of DDT or DDT-d. Additive chlorination of benzene-d_6 in ultraviolet light yielded the isomeric benzene-d_6-hexachlorides. Isolation, purification, and testing of the γ-isomer was accomplished; an isotope effect of approximately 2 was observed both on a DDT-resistant strain of Culex quinquefasciatus and a dieldrin-resistant strain of Anopheles albimanus. The methylene group of the side chain and the 3-position of the aromatic ring exchanged H for D to the extent of 98% when two equivalents of NaOD were refluxed with one equivalent of 2,4-dichlorophenoxyacetic acid in 50 molar equivalents of heavy water for 24 hours. The 2,4-D-d_3 was not different from 2,4-D in studies on corn mesocotyl elongation and root growth inhibition. Synthesis of 2,4-D, deuterated in the 6- position of the aromatic ring, was accomplished. It was found to induce less RNA synthesis by isolated plant tissue than 2,4-D. p-Chlorobenzyl p-chlorophenyl sulfide was refluxed and stirred in dioxane containing one equivalent of NaOD and an excess of D_2O for twenty-four hours. The methylene group of the molecule was found to be 98 to 100% deuterated by nuclear magnetic resonance spectroscopy. Testing results on mites showed that it was non-toxic to the resistant strain. The base-catalyzed rate of exchange of the methylene protons of the side chain and the proton in the 3-position of the aromatic ring of 2,4-D was studied. Nuclear magnetic resonance data indicated that the rate of exchange was of the same order at ring and side chain positions. Ring halogen substitution was less than 10^{-5} relative to the exchange. Reduction by lithium aluminum deuteride of the appropriate dichloromethylenedioxybenzene intermediate was the manner by which deuterium was introduced into the methylenedioxy group of several synergists which were prepared and compared with their protiated isotopomers. The synthetic route used to obtain the latter differed only in the use of lithium aluminum hydride in place of deuteride. Three of the most important intermediates prepared were piperonal-d_2, dihydrosafrole-d_2, and isosafrole-d_2. From these three intermediates sesoxane-d_2, piperonyl butoxide-d_2, 3,4-methylene-d_2-dioxyphenyl N-methylcarbamate, and sulfoxide-d_2 were prepared. The tests on these compounds demonstrated significant in vivo isotope effects. The base-catalyzed exchange of m-isopropylphenol was two equivalents of NaOD in heavy water yielded m-isopropylphenol-2,4,6-d_3. Reaction of the deuterated phenol with methyl isocyanate yielded m-isopropylphenyl-2,4,6-d_3 N-methylcarbamate. Testing of this compound against female house flies showed the deuterated carbamate to be slightly less effective as an insecticide. I_{50} tests showed the deuterated compound to be half as effective in its action as an inhibitor against house fly cholinesterase. Biological studies reported herein were conducted by collaborating biologists. (Dissertation Abstr.)

23906 IMPROVEMENTS IN OR RELATING TO FLUIDIZED BED REACTORS. Rowe, Peter Noel (to United Kingdom Atomic Energy Authority). British Patent 1,059,327. Feb. 15, 1967. Filed Nov. 1, 1962.

A method is described for operating a fluidized bed reactor that comprises passing a first gas into the base of the reactor at a rate sufficient to bring about fluidization of the bed and then injecting a second gas separately into the base of the reactor in such a manner as to cause the formation of bubbles of the second gas. The second gas is preferably chemically inert to both the bed material and the reactant gas. The reactor is described with particular reference to the system in which the bed is formed of UO_2 with HF as the reactant gas and N_2 as the inert gas and to the system in which a hydrocarbon catalyst is used as the bed material with the reactant gas being a mixture of an unsaturated hydrocarbon and H_2 and the inert gas again being N_2. (B.L.M.)

23907 A STUDY OF METAL-LIGAND REACTIONS BY ISOTOPE EXCHANGE. Sivaramakrishnan, Swaminathan. Ontario, Univ. of Toronto, 1965.

Thesis.

Kinetic studies of the following isotopic exchange reactions were carried out at 20°C and in 0.05M acetate buffer solution: $^*Co^{2+} + CoL^{2-} \rightleftharpoons {}^*CoL^{2-} + Co^{2+}$ and $Zn^{2+} + {}^*ZnL^{2-} \rightleftharpoons ZnL^{2-} + {}^*Zn^{2+}$, where * refers to an atom of ^{60}Co or ^{65}Zn and L^{4-} refers to the ethylene diamine tetra-acetate ion (EDTA). The rate of exchange of cobalt ion with cobalt-EDTA chelate in a concentration range of 10^{-3} to 10^{-4} M for both the species and at a pH from 4.8 to 6.1 was found to be given by the equation $R_{\text{mole/liter/min}} = k_{1A}[Co^{2+}][CoL^{2-}] + k_{2A}[CoL^{2-}][\overset{+}{H}] + k_{3A}[Co^{2+}][CoL^{2-}][\overset{+}{H}]$, where k_{1A} = 4.18 liter/mole/min, k_{2A} = 698 liter/mole/min, and $k_{3A} = 5.96 \times 10^5$ liter^2/mole^2/min. Activation energies corresponding to k_{1A}, k_{2A}, and k_{3A} were evaluated from further rate measurements at 30 and 40°C and the values found were 16.0, 12.1, and 10.6 kcal/mole respectively. The rate of exchange of zinc ion with zinc-EDTA complex in a concentration range from 10^{-3} to 10^{-6} M for both the species and at a pH from 5.94 to 6.96 was found to be given by the equation: $R_{\text{mole/liter/min}} = k_{1B}[Zn^{2+}][ZnL^{2-}] + k_{2A}[ZnL^{2-}][\overset{+}{H}] + k_{3B}[ZnL^{2-}][\overset{+}{H}]^2 + k_{4B}[ZnL^{2-}]$, where k_{1B} = 248 liter/mole/min, k_{2B} = 4548 liter/mole/min, $k_{3B} = 7.96 \times 10^5$ liter^2/mole^2/ min, and k_4 = 0.00463 min^{-1} and the corresponding activation energies were 29.2, 12.5, 1.6, and 7.7 cal/mole, respectively. For comparison with the cobalt and zinc exchange reactions with their EDTA complexes, kinetic studies of the cross reaction: $^*Co^{2+} + ZnL^{2+} \rightleftharpoons {}^*CoL^{2-} + Zn^{2+}$ were also performed. The exchange reactions in every system appeared to involve unprotonated complexes of cobalt and zinc with EDTA as well as the species such as $HCoL^-$, $HZnL^-$, H_2ZnL, and $CoOH^+$. Attempts were made to interpret the results on the basis of the different predictions of Pauling's Valence Bond Theory and the Crystal Field Theory. (Dissertation Abstr.)

Radiation and Nuclear Chemistry

Refer also to abstract 24859.

23908 (BNL-50042) PROCESS RADIATION DEVELOPMENT PROGRAM SUMMARIES. Sixth Annual Contractors Meeting, September 26-27, 1966. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. 78p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Twenty-three articles are included on: the search for ionic chain radiation reactions; radioinduced addition of methylsilane and dimethylsilane to ethylene; radioinduced codimerization of ether-unsaturate mixtures; heterogeneous radiation chemistry; radioinduced polymerization and copolymerization of unusual monomers; radioinduced emulsion polymerization; operations program of the high intensity radiation development laboratory; calculation of beta particle slowing down; source development; ^{137}Cs, ^{60}Co comparison; dosimetry; temperature distribution in targets; radiation chemical reactor design; development of a radioactive pebble bed chemical reactor system; effects of radia-

tion on aqueous solutions of water-soluble polymers; semiconductor device fabrication by neutron transmutation techniques; potential microbial inhibition systems employing radiation; nuclear radiation processing of optical maser materials; radiation processed wood–plastic combinations; physical and mechanical properties of wood–plastic combinations; radiation processing program at BNL; engineering-scale studies on the radioinduced polymerization of ethylene; and radioinduced synthesis of ethylene polysulfones. (P.C.H.)

23909 A STUDY OF THE PRIMARY PROCESSES IN CH_2O AND CD_2O PHOTOLYSES. DeGraff, Benjamin A.; Calvert, Jack G. (Ohio State Univ., Columbus). J. Amer. Chem. Soc., 89: 2247-53(May 10, 1967).

The primary process occurring on photolysis of CH_2O and CD_2O were delineated at 3340, 3130, 2654, and 2537 A through experiments with added olefin, neopentane, and biacetyl. The data provide estimates of primary quantum efficiencies of the process: $CH_2O + h\nu \rightarrow H + HCO$ (I) and $CH_2O + h\nu \rightarrow H_2 + CO$ (II). Information was also obtained on the nature and lifetimes of the excited states involved in these processes. The data show process I is favored at the longer wavelengths (3340 A), while II dominates at the shorter wavelengths (2537 A). Data from the photolyses of pure formaldehyde and its mixtures with propylene show values of $\Phi_{CO} - \Phi_{H_2}$ which are significantly greater than zero. The data are most consistent with the occurrence of a newly postulated reaction sequence ($H + CH_2O \rightarrow CH_3O$; $CH_3O + CH_2O \rightarrow CH_3OH + HCO$), which leads to methanol formation and a carbon monoxide excess. The additional possibility exists of a contribution to the carbon monoxide excess from a third primary process, $CH_2O^* + CH_2O \rightarrow CH_3OH + HCO$ (III), particularly in photolyses at the very long wavelengths (3660 A). (auth)

23910 EVIDENCE FOR TRAPPED DIELECTRONS IN ICE. Zimbrick, John; Kevan, Larry (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc., 89: 2483-4(May 10, 1967). (COO-1528-11).

Studies were made on trapped electrons, e_t^-, in frozen solutions of 10.0 and 6.0M NaOH, γ irradiated at 77°K. Yields of e_t^- and O^- were measured by EPR under conditions where power saturation was absent. Results indicated that at high radiations doses e_t^- reacted to form a diamagnetic species described as a dielectron, e_{2t}^{2-}, or two electrons trapped in the same hydroxide anion vacancy. (J.G.B.)

23911 USE OF ORGANIC SOLVENTS IN SEPARATING RADIOACTIVE ISOTOPES BY PRECIPITATION OR LEACHING. Rudenko, N. P.; Zhukovskaya, A. S. (Moscow State Univ. Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, (11), Ser. Khim. Nauk, No. 3, 28-32(1965). (In Russian).

An attempt was made to find the conditions for the maximum precipitation of the target element with minimum contamination from the carrier-free product. Thus, in separating ^{22}Na from Mg or ^{7}Be from Li, the $MgSO_4$ or Li_2SO_4 was precipitated with an aqueous–organic mixture of water–acetone, water–ethyl alcohol or water–dioxane. The best medium for the maximum extraction of ^{22}Na with minimum solubility of $MgSO_4 \cdot 6H_2O$ was a 10 to 15% mixture of acetone or dioxane with water. The precipitate $Li_2SO_4 \cdot H_2O$ was obtained on adding ethyl alcohol to a saturated solution of lithium sulfate containing a small excess of sulfuric acid. A linear absorption isotherm described by the equation N–KC was observed. Here N is the amount of microcomponent adsorbed per unit weight of precipitate; C is the concentration of microcomponent in solution under equilibrium conditions; K is a constant. (TTT)

23912 CONVERSION OF N-HEXANE OVER ALUMINA–CHROMIA–POTASSIA CATALYST IN A NUCLEAR REACTOR. Spitsyn, V. I.; Shuikin, N. I.; Mikhailenko, I. E.; Petrova, O. M. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 171: 907-10(Dec. 1, 1966). (In Russian).

A study was made of the behavior of alumina–chromia–potassia catalyst under the action of ionizing radiation. A catalyst was chosen having a composition of 90.7 mole % alumina, 5.6 mole % chromia, and 3.7 mole % potassia. It was used in the conversion of n-hexane. The catalyst samples were irradiated in a nuclear reactor with slow neutrons and gamma rays. Experimental data show that irradiation of the catalyst results in significant increases in the yield of benzene. With repeated use of the catalyst the benzene yield remained at a level corresponding to that of the unirradiated catalyst. Irradiation also appeared to affect the selectivity of the catalyst. (JPRS)

23913 TRANSFORMATIONS OF FREE RADICALS UNDER THE ACTION OF LIGHT IN GAMMA-IRRADIATED METHYLAMINES. Pukhal'skaya, G. V.; Kotov, A. G.; Pshezhetskii, S. Ya. Dokl. Akad. Nauk SSSR, 171: 1380-3(Dec. 21, 1966). (In Russian).

In order to ascertain whether free valence transitions are possible between different atoms, particularly transitions between nitrogen and carbon, the spontaneous, as well as ultraviolet-induced transformations of free radicals in gamma-irradiated aliphatic amines (methylamine, dimethylamine and trimethylamine) were studied. Irradiation using a ^{60}Co gamma source and DRSh-500 lamps, as well as recording of EPR spectra and of absorption spectra were carried out at a temperature of 77°K. When necessary, the irradiation with light was done directly in the resonant cavity of a microwave spectrometer. The results are discussed in detail. (JPRS)

23914 ECONOMIC CONSIDERATION ON INDUSTRIAL APPLICATION OF RADIATION CHEMISTRY. Danno, Akibumi (Japan Atomic Energy Research Inst., Tokyo). Kagaku Kogyo, 17: No. 9, 1-7(Sept. 1966). (In Japanese).

In the industrialization of radiation chemistry, the four following areas are important: sufficient basic studies; technological possibilities; economics; and marketability of the products. Viewed from this standpoint, the only radiation-chemical process developed to the commercial stage is the production of ethyl bromide by the hydrobromination of ethylene using gamma irradiation. The cost for the production of ethyl bromide by this process is estimated. When the plant capacity is taken as 454 tons/year, the investment for the plant construction is 4.38×10^7 yen, and the total cost is 309 to 511 yen/kg ethyl bromide, depending on the method of shipment. The cost for irradiation is estimated to be only 9 yen/kg ethyl bromide, which may be decreased with an increase in plant capacity. (NSA of Japan)

23915 RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Sawayanage, Shoichi; Machi, Sueo (Japan Atomic Energy Research Inst., Tokyo). Kagaku Kogyo, 17: No. 9, 21-4 (Sept. 1966). (In Japanese).

Results of the gamma-induced polymerization of ethylene are described. The G value for monomer consumption depended largely on the pressure and reached 3.4×10^4 at 400 kg/cm^2. The rate of chain-initiating reaction was directly proportional to the dose rate and the monomer concentration. The velocity of the chain propagation reaction was shown to be proportional to the second power of the monomer fugacity; the apparent activation energy of the reaction was –9 kcal/mole. The chain branching reaction was concluded to result from the displacement of free radicals in the growing polymer chains. Two types of the reaction apparatus, one with a 1 liter reactor and the other with a 10 liter reactor, were constructed for the polymerization of ethylene by continuous flowing of the monomer in the gamma field. The reaction conditions in the smaller apparatus were as follows: dose rate 3.8×10^5 rad/hr; reaction pressure 400 kg/cm^2; reaction temperature 30°C; and monomer flow-rate 300 to 3000 N. liter/hr. The space-time yield of polymer was 9 to 14 g/liter hr and decreased with an increase in the flow rate of the monomer. The block diagram of the larger apparatus and some of the properties of the polymers obtained by this apparatus are also shown. (NSA of Japan)

23916 EFFECTS OF IONIZING RADIATION ON THE MOLECULAR WEIGHT OF CRYSTALLINE POLYPROPYLENE. Geymer, D. O. (Shell Development Co., Emeryville, Calif.). Makromol. Chem., 99: 152-9(1966).

Absolute molecular weight was determined on samples of crystalline polypropylene before and after irradiation in a vacuum. Some of the chain fracture was produced directly by irradiation, and some occurred days later by a reaction between trapped free radicals and atmospheric oxygen when the ampoules were opened to remove the polymer. The latter reaction was the cause of the abnormally large decrease in molecular weight of polypropylene when it was irradiated at low doses in a vacuum and subsequently exposed to the atmosphere. When the trapped free radicals in irradiated polypropylene were destroyed with methyl mercaptan prior to the admission of air, scission yields became normal, and the gelation dose decreased markedly. The radiochemical yields of chain fractures and cross links at 35°C were G(chain fracture) = 0.62 and G(crosslinks) = 0.50 when oxidation was not permitted. (BBB)

23917 PRODUCTION OF CHEMICALS BY IONIZING RADIATION. Hall, G. R.; Clay, P. G. (Imperial Coll. of Science and Tech., London). Chem. Eng. (London), No. 204, CE336-43(Dec. 1966).

The action of ionizing radiation on matter is briefly reviewed to clarify differences between reactions brought about by radiation and other forms of energy. The essential features of isotopic sources, electric machines producing electron beams, and chemonuclear reactors are considered; and their application to chemicals production is discussed. Uses in polymer cross-linking, copolymerization, sulfoxidation, and production of ethyl bromide and polyethylene are examined. The facility offered by the irra-

diation process for tailoring the polymer and the possibility of producing ethylene copolymers (e.g., with carbon monoxide) has stimulated industrial interest. (BBB)

23918 RADIATION-INDUCED FORMATION OF ALKYLTIN BROMIDES. PART II. Fentiman, A. F.; Wyant, R. E.; McFarling, J. L.; Kircher, J. F. (Battelle Memorial Inst., Columbus, Ohio). J. Organometal. Chem., 6: 645-51(1966).

The course and rate of the ^{60}Co radioinduced reaction of Sn and 1-bromoalkanes as affected by temperature, radiation intensity, and total dose were studied. The radioinduced reaction between Sn and organic bromides was shown to give high yields of organotin products and could be made to go to completion. No thermally induced reaction occurred at the temperatures used in the radiation experiments, and dialkyltin dibromides were the principal products. The main characteristics of the radioinduced reaction were an inverse-square-root relation between G value and radiation intensity and a positive activation energy. G values above 10^3 were achieved, indicating a chain reaction in which chain lengths of 10^2 to 10^3 were readily attained. Such reactions were obtained with various alkyl bromides. (BBB)

23919 EFFECT OF DISLOCATION DENSITY ON THE RADIATION EXPANSION OF THE VOLUME OF CRYSTALS. Kalnin, D. O.; Shvarts, K. K.; Feldmane, E. E. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 6, 101-2(1966). (In Russian).

Specimens of cleaned 10 × 10 × 2 mm LiF crystals with a mean dislocation density of 10^4 cm^{-2} and LiF crystals plastically deformed at 1000°K with 10^8 cm^{-2} dislocation density subjected to etching in $FeCl_3$ solutions were irradiated at 4×10^{14} to 10×10^{17} n/cm^3. The results showed that increased dislocations from 10^4 to 10^8 cm^{-2} have a negligible effect on radioinduced volume expansion at radiation doses up to 5×10^{16} n/cm^3. (R.V.J.)

23920 RADIOCHEMICAL SYNTHESIS OF DICHLORO- AND TRIALKYLPHOSPHINES. Babkina, E. I.; Vereshchinskii, I. V. Zh. Obshch. Khim., 37: 513(Feb. 1967). (In Russian).

A method is suggested for radiochemical synthesis of dialkylchloro- and trialkylphosphines by γ-irradiation of a liquid mixture of alkyldichlorophosphine ($RPCl_2$) and any hydrocarbon (R'H) producing 50 to 60% dialkylchlorophosphine (RR'PCl) and 10 to 15% trialkylphosphine (RR'_2P). A series of dialkylchlorophosphines were synthesized (R_2PCl), where R = C_6H_{13}, Δ-C_6H_{11}, and C_5H_{11}. (R.V.J.)

23921 THE CHEMICAL EFFECT OF γ RADIATION FROM ^{60}Co ON AQUEOUS SOLUTIONS OF GOLD CHLORIDE. II. EFFECTS OF TEMPERATURE. Koulkes-Pujo, Anne-Marie; Rashkov, Stephane (Institut du Radium, Paris). J. Chim. Phys., 64: 534-9(Mar. 1967). (In French).

The influence of the concentration of gold chloride and of temperature on the radiolysis of this salt in aqueous solutions was studied. The experimental results confirmed the kinetics scheme by which it was established that the radiolytic reduction yield of aerated solutions was independent of the solute concentration in the concentration range studied and also that the temperature effect was the consequence of the reaction of hydrogen peroxide with the solute. (auth)

23922 ELECTRIC CONDUCTIVITY AND RADIOLYSIS OF HYDROCARBONS IRRADIATED BY γ RAYS. Gibaud, Remy (Faculte des Sciences, Bordeaux). J. Chim. Phys., 64: 521-8 (Mar. 1967). (In French).

Conductivity induced by gamma radiation from radium in seven aromatic hydrocarbons and eleven alkanes was studied between about −20°C and +80°C. Ionization currents increased with temperature; the corresponding activation energies, of the order of 0.05 eV decreased as the electric field increased. The saturation current, obtained according to Jaffe's theory, was independent of the temperature for all the compounds studied. This current varied little with the length of the alkane chain, but increased strongly when the molecule possessed methyl substituents. Presence of substituents also increased the saturation current of the aromatic hydrocarbons, as a rule less reactive than alkanes. A linear relation was obtained between this saturation current and the radiolytic yield in methane and hydrogen in the case of the aromatic hydrocarbons. In the case of the alkanes only a good correlation was found. (auth)

23923 GAMMA RADIOLYSIS OF AQUEOUS SOLUTIONS CONTAINING Fe(II) AND SELECTED SUBSTITUTED PHENOLS. Ahren, R. W. (E. I. Du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Radiat. Res., 30: 611-19(Mar. 1967).

In oxygen-saturated aqueous solutions, either 4,5-dihydroxy-2,7-naphthalenedisulfonic acid or 1,3-dihydroxynaphthalene inhibits the γ-induced oxidation of Fe^{2+} more efficiently than hydrazine or any of a series of substituted phenols studied. The results for 4,5-dihydroxy-2,7-naphthalenedisulfonic acid are explained quantitatively by assuming that, at concentrations below 10^{-3} M, the phenol reacts with OH radicals to form a product that has an optical absorption maximum at 4200 Å, probably the semiquinone. The rate constant determined for this reaction is 5.5×10^8 M^{-1} sec^{-1}. In a solution irradiated, subsequently deaerated, and irradiated again, the oxidation reaction is reversed, and a net loss of the oxidation product is observed. At concentrations of 4,5-dihydroxy-2,7-naphthalenedisulfonic acid >10^{-2} M, the kinetics of the radiolytic reactions are more complicated, and no attempt was made to establish a detailed mechanism under these conditions. (auth)

23924 PULSE RADIOLYSIS STUDIES. XI. PROTONATION REACTIONS OF AROMATIC ANIONS IN SOME ALIPHATIC ALCOHOLS. Arai, Shigeyoshi; Tremba, E. L.; Brandon, J. R.; Dorfman, Leon M. (Ohio State Univ., Columbus). Can. J. Chem., 45: 1119-23(May 15, 1967).

The protonation reaction of aromatic anion radicals in the aliphatic alcohols, $Ar^- + ROH = ArH^- + RO^-$, was investigated by the pulse radiolysis method. Activation energies for this reaction were determined for the anthracenide anion and diphenylide anion in methanol, ethanol, and isopropanol, and for the naphthalenide anion in isopropanol. Absolute rate constants were determined as well for the phenanthrenide, o-terphenylide, and m-terphenylide anions in isopropanol at 25°C. The values for the rate constants, activation energies, and the preexponential factors are given. Those properties of the system that determine the kinetics are briefly discussed. (auth)

23925 THE RADIOLYSIS OF GASEOUS MIXTURES OF METHYLAMINE AND AMMONIA AND ITS BEARING ON THE RECOIL CHEMISTRY OF CARBON ATOMS IN AMMONIA. Cacace, Fulvio; Di Marco, Giorgio (CNR, Rome. Univ., Rome). Radiochim. Acta, 6: 187-90(Dec. 1966).

The yield of methane from the gas phase radiolysis of methylamine in a diluted condition in mixtures with ammonia was studied at a fixed radiation dose as a function of the methylamine concentration. It was found that the methane yield, expressed as a percentage of the initial amount of methylamine, increases with the dilution, reaching a value of about 30% for the greatest dilution studied. In this case 2×10^{-2} mole % of methylamine was irradiated with a dose of 5×10^{-1} eV per molecule. The results are discussed with reference to previous experiments on the reactions of energetic carbon atoms produced by nuclear techniques in gaseous ammonia. The present results support the conclusion that a considerable fraction of the ^{11}C-methane yield, observed in the recoil experiments carried out at high doses, arises from the radiolytic reduction of already formed ^{11}C-methylamine. It was also observed that the addition of oxygen to the methylamine–ammonia mixtures completely prevents the radiolytic formation of methane. (auth)

23926 POLYMERIZATION OF ITACONIC ACID DERIVATIVES. Ishida, Shinichi; Saito, Shizuko (Asahi Chemical Industry Co., Ltd., Tokyo). J. Polym. Sci., Pt. A-1, 5: 689-705(Apr. 1967).

The γ-ray-initiated polymerization of dimethyl itaconate was studied. Dimethyl itaconate was polymerized by γ irradiation at temperatures where the monomer does not polymerize thermally. As long as the monomer was kept in a liquid state, even at temperatures below the melting point, the polymerization took place. Itaconic anhydride was polymerized in the solid state with γ irradiation or benzoyl peroxide. The molecular weight of the polymer increased with time or yield and was greater than that of polymer obtained by other methods. Kinetic and crystallographic studies indicated that the γ-ray-initiated solid-phase polymerization is a first-order reaction with respect to monomer and the rate-determining step changes as the polymerization proceeds. (auth)

23927 RADIOCHEMICAL TRANSFORMATIONS IN α-NITRONAPHTHALENE AND NAPHTHALENE. Zedelashvili, E. N.; Shanshiashvili, M. I. (Inst. of Physical and Organic Chemistry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 45: 391-6 (Feb. 1967). (In Russian).

Radiochemical transformations of crystalline naphthalene and α-nitronaphthalene were studied using purified specimens exposed in an IRT-2000 reactor to mixed (n and γ) radiation with 3.5×10^{12} n/sec doses. Irradiated naphthalene and α-nitronaphthalene chromatograms revealed prevalence of orange fluorescence for the α-nitronaphthalene and blue for the naphthalene. Two substances were separated from the naphthalene, one with blue and the other with yellow fluorescence. The first was a white platelet with a melting point of 182°C and the other a noncrystalline oily substance. The oily substance was similar to the yellow fluorescence product separated from the α-nitronaphthalene. The tests indicated great similarity of the products of radiolysis of both materials. It was postulated that the radiochemical transformation of both materials is similar resulting in an aromatic ring

and hydration by a side chain formed by hydrogen atoms isolated by the initial ionizing radiation. (R.V.J.)

23928 KINETICS OF THE γ-RADIATION-INDUCED POLYMERIZATION OF METHYL METHACRYLATE IN THE SOLID STATE. Lipscomb, N. Thornton; Weber, Edwin C. (Univ. of Louisville, Ky.). J. Polym. Sci., Pt. A-1, 5: 779-84(Apr. 1967). (TID-23143).

Studies were made on the γ-radioinduced polymerization of methyl methacrylate in bulk, in the solid state at a temperature of −65°C and a radiation intensity of 346,000 RAD/hr. The reaction was found to have an extremely long induction period (~50 hr) when pure monomer was used, and to be first-order with respect to polymer concentration. This first-order dependency was confirmed by a series of irradiations in which 0.6% poly(methyl methacrylate) was dissolved in the monomer before irradiation. These irradiations showed no induction period. Nuclear magnetic resonance spectroscopy indicated a much more heterotactic polymer than that obtained in the liquid state at −49°C. (auth)

23929 PULSE RADIOLYSIS STUDIES OF STYRENE. Metz, D. J. (Brookhaven National Lab., Upton, N. Y.); Potter, R. C.; Thomas, J. K. J. Polym. Sci., Pt. A-1, 5: 877-90(Apr. 1967). (BNL-10515).

The pulse radiolysis technique of studying short-lived, radio-induced intermediates was applied to a study of pure, dry liquid styrene. At least three distinct species were observed. The most rapidly decaying species ($\tau^1/_2$ = 4 μsec, $\lambda_{max} \approx$ 370 mμ) exhibited an apparent first-order decay which was slowed down in the presence of dry oxygen, occurred too rapidly to be measured in the presence of water, and had a temperature coefficient of approximately 1 kcal/mole between 25 and 45°C. The species was tentatively identified as the styryl anion with a G-value for formation of approximately 0.15. A second species ($\tau^1/_2$ = 220 μsec $\lambda_{max} \approx$ 320−330 mμ) exhibited a first-order decay which appeared to be independent of oxygen and water. From its spectrum, it was tentatively identified as the styryl radical. The third species ($\lambda_{max} \approx$ 310 and 320 mμ) was relatively stable in the dark, but was readily photolyzed by the analyzing light of the usual experimental setup for pulse radiolysis studies. The formation of this species appeared to be independent of the water and oxygen content of the styrene. (auth)

23930 RADICAL AND MOLECULAR PRODUCT YIELDS IN X-IRRADIATED ALKALINE AQUEOUS SOLUTIONS. Burchill, C. E.; Dainton, F. S.; Smithies, D. (Univ. of Leeds, Eng.). Trans. Faraday Soc., 63: 932-43(Apr. 1967).

Solutions containing $K_3Fe(CN)_6$ + $K_4Fe(CN)_6$ + HCOONa were x-irradiated to measure radical and molecular product yields over the pH range 10 to 13.5. G_{H_2} and $G_{e^-_{aq}}$ + G_H were constant over this range of pH. There were indications that the precisely known decrease in $G_{H_2O_2}$, which occurred when the pH was increased, was matched by an appropriate (= $2\Delta G_{H_2O_2}$) increase in G_{OH}. (auth)

23931 RADICAL AND MOLECULAR YIELDS IN THE RADIOLYSIS OF AQUEOUS SOLUTIONS. IV. NITROUS OXIDE SOLUTIONS CONTAINING HEXACHLORO-ANIONS OF IRIDIUM AND PLATINUM. Dainton, F. S.; Rumfeldt, R. (Univ. of Leeds, Eng.). Proc. Roy. Soc. (London), Ser. A, 298: 239-54(May 2, 1967).

From competition studies on γ-irradiated solutions containing Ir(III), Ir(IV), or Pt(II) and N_2O, Ge^-_{aq} was found to be 3.10 ± 0.10 at natural pH. In confirmation of previous measurements the electron yield increased in alkaline solution. Measurements of molecular yields in the iridium system indicate that at zero solute concentration at natural pH $G^0_{H_2}$ = 0.44 ± 0.02 and $G^0_{H_2O_2}$ = 0.78 ± 0.05. In alkaline solutions both Pt(IV) and Ir(III) were thermally and photochemically labile. From competition studies at natural pH $k(e^- + Ir(III)) = 7.4 \times 10^9\ M^{-1}\ S^{-1}$ and $k(e^- + Ir(IV)) = 2.6 \times 10^{10}\ M^{-1}\ S^{-1}$ and at pH 13 $(k(e^- + Ir(III)) = 1.0 \times 10^{10}\ M^{-1}\ S^{-1}$ and from pulsing experiments $k(e^- + Pt(II)) = 6.7 \times 10^9\ M^{-1}\ S^{-1}$ and $k(e^- + Pt(IV)) = 3.6 \times 10^{10}\ M^{-1}\ S^{-1}$. (auth)

23932 POLYMERIZATION OF ETHYLENE BY γ-RAYS. I. PURE ETHYLENE. Dauphin, J.; Grosmangin, J.; Petit, J. C. (Compagnie Francaise de Raffinage, Gonfreville l'Orcher, France). Int. J. Appl. Radiat. Isotop., 18: 285-96(May 1967). (In French).

The gamma-induced polymerization of pure ethylene was studied systematically. Variations of the polymerization rate and of the resulting molecular weights were investigated in the following ranges: pressures from 70 to 500 atm, temperatures from −25 to 135°C, and dose rates from 8 to 16,000 rad/min. The polymer formed at low temperature had the appearance of a very fine powder and its specific surface area was large. This decreased as the temperature increased and could no longer be measured when the temperature reached 90°C; the polymer particles then stuck together. The variations of the specific surface area had a considerable influence on the rate of polymerization and on the molecular weights. These facts led to the assumption of the coexistence of two mechanisms of polymerization: one is classical and takes place in the homogeneous phase; the other involves growing from the polymer surface. This assumption remains valid as long as the specific surface area of the polymer keeps a measurable value. Such a hypothesis should explain qualitatively the main features of the reaction. (auth)

23933 POLYMERIZATION OF ETHYLENE BY γ-RAYS. II. INFLUENCE OF IMPURITIES AND ADDITIVES. Dauphin, J.; Grosmangin, J.; Petit, J. C. (Compagnie Francaise de Raffinage, Gonfreville l'Orcher, France). Int. J. Appl. Radiat. Isotop., 18: 297-305(May 1967). (In French).

The gamma-induced polymerization of ethylene was studied in the presence of various impurities and additives. Oxygen, water, carbon dioxide, and propylene induced inhibition periods, followed by slower polymerization than for pure ethylene. Oxygen was the most effective inhibitor. A reduction of the rate occurred in the presence of acetylene; it probably copolymerizes with ethylene. Hydrogen, methanol, and saturated hydrocarbons had only a slight effect on the rate of polymerization and reduced the molecular weights. The influence of ammonia was quite different. It increased the polymerization rate but had a minor effect on the molecular weights. Several hypotheses were suggested for explaining this. An increase in radical yield could occur by charge transfer, excitation transfer, or proton transfer. As the polymerization takes place mainly on the polymer surface area, ammonia could cause a physical effect, altering the interactions between monomer and polymer. Ammonia could also react with traces of impurities, such as with carbon dioxide. A choice could not be made among these various mechanisms, but they could work simultaneously. (auth)

23934 PREPARATION OF ^{234}Pa(UZ) AND ^{234m}Pa(UX2) SOURCES WITH HIGH SPECIFIC ACTIVITY. Bouissieres, Georges; Legoux, Yvette; Merinis, Jean; Muxart, Roland; Ossart, Pierre; Vernois, Jacques (Institut de Physique Nucleaire, Orsay, France). Bull. Soc. Chim. France, No. 3, 934-6(Mar. 1967). (In French).

A two-stage procedure to obtain ^{234}Pa and ^{234m}Pa is described. The first step is a separation of a few milligrams of thorium from about one hundred kilograms of uranium by extracting with tributyl phosphate. The second step is a thorium−protactinium separation by vaporizing chlorides inside a tube with a temperature gradient. The very high specific activity of ^{234}Pa sources is convenient for studying spectra of conversion electrons of this nucleide. (auth)

23935 EFFECT OF GAMMA-RADIATION ON PROPERTIES AND STRUCTURE OF ETHYLENE−PROPYLENE COPOLYMERS. Orszagh, Andrzej; Obloj, Jozef (Univ., Warsaw. Inst. of Heavy Organic Synthesis, Blachownia Slaska, Poland). Rocz. Chem., 41: 617-25(1967). (In Polish).

In a study of the effects of gamma radiation on ethylene−propylene copolymers it was found that simultaneously with cross-linking a degradation reaction occurs. Degradation increased with increasing propylene content in the macromolecule. The effects of dose and propylene content on the gel formation process were examined. The G_H was determined and found to decrease with increase of dose or propylene content. The disappearance of primary unsaturated bonds is discussed. (D.H.M.)

23936 PARAMAGNETIC RELAXATION OF TRAPPED HYDROGEN ATOMS IN IRRADIATED FROZEN SOLUTIONS. Zimbrick, J.; Kevan, L. (Univ. of Kansas, Lawrence). Nature, 214: 693(May 13, 1967).

Trapped electrons in irradiated alkaline ices showed no change in relaxation time over a dose range of 0.2 to 3MR; this implied that the electrons are trapped in spurs. The studies described report measurements on trapped hydrogen atoms in which the relaxation time decreased with dose in the range 0.5 to 5MR. Reasons are given for postulating that sites trapping the hydrogen atoms are not located in a spur produced by irradiation, and experimental work to test this postulate is described. Frozen solutions of 8M H_2SO_4 and D_2SO_4 were gamma irradiated at 77°K, and the slow passage progressive power saturation was measured with an EPR spectrometer. Results are discussed, and it was concluded that the H-atoms were not trapped in a spur. (UK)

23937 ESR STUDY ON RADIATION-INDUCED POLYMERIZATION OF ISOBUTENE. Tsuji, Kozo; Yoshida, Hiroshi; Hayashi, Koichiro; Okamura, Seizo (Kyoto Univ.). J. Polym. Sci., Pt. B, 5: 313-16(Apr. 1967).

A study of the initiation process of radioinduced polymerization of isobutene, which is known to polymerize with the cationic mechanism, was made using the electron spin resonance (ESR) technique. The spectra obtained from a mixture of 3-methylpentane and isobutene after irradiation with gamma radiation at 77°K was compared to the spectra from irradiated bulk isobutene and from

irradiated 3-methylpentane. A tentative interpretation of the ESR spectra is as follows: when pure 3-methylpentane is irradiated, ejected electrons recombine readily with their parent cations, and therefore they are trapped rather unstably. When isobutene is added to 3-methylpentane, the parent cations transfer their positive charge to isobutene, so that cation-radicals of isobutene are formed. Polymerization proceeds from the cation radicals by a cation mechanism, leaving a neutral free radical at one end of the propagating chain. The ejected electrons lose their counterpart to recombine with and are trapped stably. (D.H.M.)

23938 MASS-SPECTROMETRIC STUDY IN THE RADIATION-INDUCED POLYMERIZATION OF NITROETHYLENE. Yamaoka, Hitoshi (Kyoto Univ.); Shiga, Tetsuo; Hayashi, Koichiro; Okamura, Seizo; Sugiura, Toshio. J. Polym. Sci., Pt. B, 5: 329-31 (Apr. 1967).

An investigation of the active species in the radioinduced polymerization of nitroethylene (NE) was made using a mass spectrometer. Many kinds of negative ions from NE were observed by electron impact at 100-eV. At a pressure of 7×10^{-7} mm Hg, the molecular negative ion of NE (NE^-, M/e = 73) was found, although the relative yield was rather low. It was also found that the ionization efficiency curve of NE^- was closely similar to that of SF_6^- ion formed from SF_6, and the appearance potential of NE^- was about zero. These results indicate that NE is a strong electron acceptor. It was observed that the yield of NE^- as well as that of dimer anion of NE increased with increasing pressure. The addition of krypton or xenon, which facilitates the collisional stabilization, gave higher relative yields of NE^- and dimer anion. (D.H.M.)

23939 INFRARED SPECTRA OF IRRADIATED POLY-3-METHYL-BUTENE-1. Luongo, J. P. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Polym. Sci., Pt. B, 5: 281-4(Apr. 1967).

The infrared spectra of electron-irradiated isotactic poly-3-methyl-1-butene (1,2 enchainment) were studied. The samples were irradiated in a beam of 1-MeV electrons from a Van de Graaff generator. A strong increase in vinylidine unsaturation ($R_1 R_2 C=CH_2$) and only a small increase in trans (CH=CH) unsaturation was found. Irradiation was also carried out at low doses in evacuated glass tubes and the evolved gases analyzed by mass spectrometry. In addition to the expected high concentration of hydrogen, large amounts of propane, about 1/6 as much methane, and no ethane were detected. The mechanism of one of the major structural rearrangements that can occur on irradiation is postulated. Spectral changes were also observed during the room temperature aging of an irradiated sample. (D.H.M.)

23940 STEREOREGULARITY OF POLYACRYLONITRILE AND ITS DEPENDENCE ON POLYMERIZATION TEMPERATURE. Murano, Masao; Yamadera, Reizo (Toyobo Co. Ltd., Katata, Japan). J. Polym. Sci., Pt. B, 5: 333-8(Apr. 1967).

The nuclear magnetic resonance (NMR) spectra of polyacrylonitrile (PAN) prepared at −15, 0, 20, 60, and 100°C using azobisisobutyronitrile as an initiator were studied. Gamma radiation was used to initiate polymerization at −78, 0, and 20°C. α-Deuteroacrylonitrile was polymerized under the same conditions. The differential enthalpy and entropy for syndyotactic and isotactic monomer placement in the chain propagation was calculated. The σ values obtained using gamma radiation were the same as those obtained using free radical initiation except at −78°C. The σ value at −78°C was the same as those of PAN obtained in the solid state. Acrylonitrile takes solid state at −78°C and the polymerization mechanism at this temperature may differ from that in the liquid state. (D.H.M.)

23941 EFFECTS OF X RADIATION ON METHIONINE. Wacker, A.; Moustafa, Z. H.; Lochmann, E.-R. (Univ., Frankfurt am Main). Biophysik, 3: 207-12(1966). (In German).

By investigating the effects of x radiation (50 to 200 kR) on carboxyl-^{14}C-, 2-^{14}C-, and $^{14}CH_3$-labeled methionine and on nonradioactive labeled methionine, it could be established that the following conversion products are formed: methionine sulfoxide (MSO), α-hydroxy-γ-methylmercaptobutyric acid (HMMB), β-methylmercaptopropionic acid (MMP), and homocysteine (HC). MSO and the γ-mercapto-α-ketobutyric acid assumed as intermediate stages could not be detected. No splitting of the S−CH_3 group (for example, to α-aminobutyric acid) and no formation of methioninesulfone were found. These were described by other authors after irradiation with higher doses. At a dose of ≦50 kR, only MSO could be found as a conversion product. The effect of H_2O_2 on methionine yields quantitatively the same conversion products; however, the mass ratios of the products formed differ clearly from the values obtained after irradiation. (tr-auth)

23942 RADIATION-INDUCED ADDITION REACTIONS OF ETHERS AND ALCOHOLS TO PERFLUOROPROPENE. Muramatsu, Hiroshige; Inukai, Kan; Ueda, Teruo (Government Inst. Research Inst., Nagoya, Japan). Bull. Chem. Soc. Jap., 40: 903-7(Apr. 1967).

The radioinduced addition reactions of ethers and alcohols to perfluoropropene were studied. The 1:1 adducts were obtained in excellent yields, but in the addition of diethyl ether and dioxane the 1:2 adduct with a symmetrical structure was produced along with the 1:1 adduct. The ethers containing the perfluoropropenyl group were prepared by the dehydrofluorination of the corresponding 1:1 adduct. From the proton and fluorine NMR spectra, the attacks of the α-ethereal and α-hydroxyalkyl radicals were found to occur exclusively on the difluoromethylene carbon. The relative reactivities of ethers and alcohols were determined by competitive reaction. (auth)

23943 THE ADDITION REACTIONS OF ETHANOL TO ETHYLENE INDUCED BY GAMMA-RAY IRRADIATION IN THE GASEOUS PHASE. I. RESULTS AND THE REACTION MECHANISMS. Hotta, Hiroshi; Kurihara, Hirondo; Abe, Toshihiko (Japan Atomic Energy Research Inst., Takasaki). Bull. Chem. Soc. Jap., 40: 714-18(Apr. 1967).

In the reactions studied, the major products in the gaseous phase were 2-alkanols, 3-methyl-3-alkanols, and 2-ketones, while low hydrocarbons were found only at temperatures higher than about 150°C. The reactions in the liquid phase, carried out at 100°C, did not give 2-ketones. The major primary precursor was the 1-hydroxyethyl radical. The radicals produced by its addition to ethylene, $CH_3-CH(OH)-(CH_2)_{2n}$, gave not only 2-alkanols but also radicals, $CH_3-C(OH)-(CH_2)_{2n-4}-CH_3$, as a result of rearrangement by the intramolecular hydrogen transfer. Some of the latter radicals acted as precursors of 3-methyl-3-alkanols by their addition to ethylene, while the rest of the radicals gave 2-ketones by hydrogen abstraction by ethylene. The latter reaction gave the ethyl radical, which was the precursor of various hydrocarbons. The intramolecular hydrogen transfer occurred even in the liquid phase to give 3-methyl-3-alkanols, but the rearranged radicals gave 2-ketones only in the gaseous phase. (auth)

23944 THE ADDITION REACTIONS OF ETHANOL TO ETHYLENE INDUCED BY GAMMA-RAY IRRADIATION IN THE GASEOUS PHASE. II. A KINETIC ANALYSIS OF THE RESULTS. Kurihara, Hirondo; Hotta, Hiroshi (Japan Atomic Energy Research Inst., Takasaki). Bull. Chem. Soc. Jap., 40: 719-23 (Apr. 1967).

In order to analyze the results obtained in Part I (H. Hotta and H. Kurihara, Bull. Chem. Soc. Japan, 40: 714 (1967)), a general kinetic expression for the system which involves side chain reactions was derived by a modification of the Gale and Wagner method (J. Am. Chem. Soc., 86: 4531 (1964)) on the basis of the G-values without the steady-state approximation. By the use of this expression, the chain transfer constants were found to be $C_1' = 0.093$ and $C_2' = 0.074$ in the gaseous phase, and about $C_1' = 0.007$ in the liquid phase. These values were compared with the reported chain transfer constants for related systems. (auth)

23945 PROCEEDINGS OF THE SECOND TIHANY SYMPOSIUM ON RADIATION CHEMISTRY. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967. 626p. $28.00. (CONF-660508).

The symposium proceedings include 95 separate papers. The publication of the papers is divided into 4 main parts entitled (1) General Problems, Inorganic and Biological Systems; (2) Aqueous Solutions; (3) Organic Compounds; and (4) Polymers. Separate abstracts were prepared for 94 papers. One paper was previously abstracted: see NSA 20: 18724. (B.L.M.)

For abstracts of individual papers see: 23896, 23897, 23946–24033, 24235–24237, and 24527.

23946 MECHANISM OF EXCITATION TRANSFER AND LOCALIZATION. Burton, M. (Univ. of Notre Dame, Ind.). pp 3-15 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Certain cases in radiation chemistry studies where the energy transfer mechanism is clearly established are reviewed. Cases of sensitized luminescence, photosensitized reactions, and gamma excitation of organic glasses are discussed. Cases in which explicit conclusions can be expressed regarding the species excited, the type of excitation, the mechanism of energy transfer, and the excited state(s) involved in the actual chemical process are reviewed in detail. (42 references.) (B.L.M.)

23947 THEORY OF RADIATION-CHEMICAL YIELD: RADIOLYSIS OF WATER VAPOR. Santar, I.; Bednar, J. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). pp 17-24 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The optical approximation approach was applied to the calcula-

tion of G for water vapor. The limitations of the approximation due to secondary electrons are considered. The results of the approximation approach for the yield and energy balance of the physical stage of radiolysis as well as the primary yields of the water decomposition are tabulated and compared with reported experimental values. (B.L.M.)

23948 RECOMBINATION KINETICS OF RADICALS INDUCED BY GAMMA IRRADIATION IN SINGLE CRYSTALS OF AMMONIUM SULPHATE. Calusaru, A.; Barbur, J.; Ursu, I. (Inst. of Atomic Physics, Bucharest. Univ. of Cluj). pp 25-32 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Paramagnetic centers in single crystals of $(NH_4)_2SO_4$ and $(ND_4)_2SO_4$ were produced by γ irradiation. Their concentration and recombination kinetics were measured by ESR as a function of time at different temperatures. The studies indicated that the recombination of the defect localized on a sulfur combination follows a random-walk process of the pairs initially correlated. Annealing of the defects localized on the ammonium verified the hot-zone recrystallization model. The results indicated that the changes appearing in the crystal lattice play an important part in the formation of the defects formed by irradiation. The activation energy of the recrystallization process was determined. (B.L.M.)

23949 RADIATION CHEMISTRY OF SOME TETRAALKYLTIN COMPOUNDS. Hoeppner, K. (Institut fuer Angewandte Isotopenforschung, Berlin). pp 33-6 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effects of x and γ radiation on tetraalkyltin compounds were studied. The radiolysis products were identified by gas chromatography, mass spectrometry, or comparison of retention times of the products with those of synthetic products. The chief radiolysis products formed from tetraethyltin were ethylene, ethane, and butane. In the radiolysis of tetramethyltin, the most important products were trimethylethyltin, hexamethylethylditin, and bis(trimethyltin)methylene. Trimethylethyltin and methyltriethyltin were identified after radiolysis of dimethyldiethyltin. Not all the products were identified. G-values are reported for some of the products, and reaction mechanisms are suggested. (B.L.M.)

23950 DETERMINATION OF THE ABSORBED ENERGY IN VINYL CHLORIDE IRRADIATED BY X RAYS. Behrens, H. (Inst. for Physics, Leipzig. Physical Chemistry of High Polymers, Leipzig). pp 37-42 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Investigations were carried out to determine the absorbed energy (absorbed dose) in vinyl chloride irradiated by 90- to 200-kV x rays from a measurement of the exposure dose. A formula is given for calculating the absorbed dose in vinyl chloride if the exposure dose is measured by an ionization chamber. Some investigations into the energy absorption in the liquid phase of vinyl chloride led to the conclusion that the mechanism of x-ray energy transfer is the same in the liquid and gaseous phases; therefore, the formula is applicable to calculations of the absorbed dose in either phase. The dependence of the energy absorption coefficients on the thickness of the vinyl chloride layer was also investigated. (B.L.M.)

23951 EFFECTS OF GAMMA RADIATION ON FOLIC ACID. Galatzeanu, I. (International Atomic Energy Agency, Vienna). pp 55-67 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effects of gamma irradiation on folic acid in solutions of 0.01N NaOH or 70% ethanol and in the solid state were investigated by ultraviolet and infrared spectroscopy, paper and thin-layer chromatography, and electron spin resonance spectroscopy. At the same radiation dose the degree of decomposition was higher for folic acid in the solutions than in the solid state. However, ethanol appeared to offer some radioprotective action. The degree of decomposition was found to be proportional to the radiation dose for solutions. Some pterins and a derivative of p-aminobenzoylglutamic acid were identified as radiolysis products. Irradiation of the acid in the solid state led to the formation of free radicals, which remained stable for several days, and the concentration of the radicals was measured as much as 8 days after irradiation. (B.L.M.)

23952 ESR STUDIES ON FREE RADICALS FORMED IN TRITIUM-LABELED AMINO ACIDS AND DICARBOXYLIC ACIDS BY SELF-RADIOLYSIS. Lassmann, G. (Inst. of Biophysics, Berlin). pp 69-78 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The ESR spectra of tritium-labeled amino acids and dicarboxylic acids are recorded after x, β, and γ irradiation at room temperature and at 90°K. The radicals formed during self-radiolysis by internal soft β irradiation were found to be the same as those after external x and γ irradiation. The radical yields as a function of absorbed dose are reported at 90°K for several compounds, and from the linear portion of the dose-response curves G-values of 1.0 to 4.4 were obtained for the formation of free radicals trapped in the solid matrix. At doses between 1×10^6 and 1×10^7 RADS, the dose-response curves indicated a saturation behavior. The highest obtainable radical concentrations were found to be in the range from 0.007 to 0.6% corresponding to an average radical distance of 24 to 6.5 molecule distances. Primarily formed unstable radicals were found to be converted to secondary more stable radicals within a short time after room temperature irradiation. The conversion of precursor radicals detectable after 90°K irradiation was demonstrated by a stepwise annealing process. The low radical yield noted in irradiation of fumaric acid at room temperature is attributed to a strong recombination of an unstable precursor radical resulting in only a small yield of final radicals by the aufbau-effect. (B.L.M.)

23953 SOME PROPERTIES OF HO_2. Bielski, B. H. J.; Allen, A. O. (Brookhaven National Lab., Upton, N. Y.). pp 81-6 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The kinetics of recombination of HO_2 radicals generated by irradiation of air-saturated water acidified with H_2SO_4 or $HClO_4$ and by the reaction of ceric sulfate with H_2O_2 were studied. The recombination rate constant was found to vary with pH but was the same for radicals formed by the two different methods. The explanation that the HO_2 radical is amphoteric is offered as an explanation for the pH dependence of the recombination constant. (B.L.M.)

23954 EFFECTS OF VARIOUS FACTORS ON THE RADIOLYTIC PRODUCT YIELDS FROM WATER. Byakov, V. M.; Ershler, B. V.; Bugaenko, L. T. (Inst. of Theoretical and Experimental Physics, Moscow). pp 87-94 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radical diffusion model was used to study some aspects of the radiolytic product yields from water. Three radical recombination reactions are suggested. The effects of scavenger concentrations on yields of molecular H_2 and H_2O_2 were established, and a mathematical analysis is presented for relating the effects. The role of the excited water molecule in the formation of molecular products under radiolytic conditions is discussed. (B.L.M.)

23955 ORIGIN OF THE YIELD OF PRIMARY HYDROGEN ATOMS IN WATER RADIOLYSIS. Sutton, J.; Moreau, M. (CEN, Saclay, France). pp 95-103 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Six different systems were examined after γ irradiation in an attempt to establish the formation of primary hydrogen atoms in water radiolysis. Competition plots are presented for the following systems: 2×10^{-5}M KNO_2–isopropanol, 2×10^{-5}M KNO_2–sodium formate, 2×10^{-5}M $CuSO_4$–isopropanol, 2×10^{-5}M $CuSO_4$–sodium formate, 2×10^{-5}M K_2CrO_4–sodium formate, and 2×10^{-5}M sodium formate–$HgCl_2$, and the yields of H_α (primary hydrogen atoms) and rate constant ratios are tabulated. The results of this study favor the hypothesis of the H_α species and cast doubt on the existence of a long lived excited state of water. (B.L.M.)

23956 TWO MECHANISMS OF HYDROGEN FORMATION IN IRRADIATED AQUEOUS SOLUTIONS. Schiller, R. (Central Research Inst. for Physics, Budapest). pp 105-10 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The following two mechanisms are considered for hydrogen formation in aqueous solutions: $e^-_{aq} + e^-_{aq} \rightarrow H_2 + 2OH^-_{aq}$ and $H + H \rightarrow H_2$. The assumption was made that water has two different spur structures with the first mechanism taking place in the disoriented water spur while the second mechanism takes place in the well-oriented ice-like spur. Using this assumption and the two mechanisms, an analytical expression was developed for the concentration dependence of molecular yield, and the calculated values are compared with measured values. A mixed-spur assumption was also made, and the set of differential equations for this case is presented in an appendix. However, it was concluded that the mixed spur type reactions practically do not occur. (B.L.M.)

23957 PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF ALKYL HALIDES. I. METHYL IODIDE SOLUTIONS. Thomas, J. K. (Argonne National Lab., Ill.). pp 115-22 of Proceedings

of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The irradiation of oxygen-free aqueous solutions of methyl iodide with pulsed electrons was found to yield two products, the iodide ion and a complex of the iodine atom with CH_3I. Spectral measurements and the effects of N_2O and OH radical scavengers led to the identification of the reaction products. The decay of the e_{aq}^- and the formation of I^- are both first order kinetics as is the self-decay of the $I(CH_3I)$ complex at low intensity. (B.L.M.)

23958 STUDIES ON THE RADIOLYSIS OF AQUEOUS IODIDE–IODINE SYSTEMS. Botar, L.; Safarik, I. (Central Research Inst. for Chemistry, Budapest). pp 123-7 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radiolytic oxidation of iodide ions is compared with that of ferrous ions. Some possible effects of H^+ ions on the oxidation of iodide ions in aqueous solutions are discussed, and a mechanism for the radiolysis of these solutions is suggested. The pH dependence of the oxidation yield in the radiolysis is a complicated phenomenon, and even though a number of different possibilities are considered, no firm conclusions are drawn. (B.L.M.)

23959 SOME COMPETITION STUDIES IN GAMMA IRRADIATED AQUEOUS SOLUTIONS AT VARIOUS pH. Draganic, I. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 129-32 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The acidity dependence of gamma-radiolysis-produced OH radical reactions with oxalic acid and with bromine ions was determined, and the rate constants over the pH range of 1.3 to 7 are presented. The OH radical was found to react faster with oxalate ions than with undissociated oxalic acid molecules. Studies of the radiolysis of alkaline oxalate solutions in the presence of O_2 and oxalic acid re-formation indicated that the reactions of O^- radicals with oxalate and formate ions are almost 3 times faster than the corresponding reactions with OH radicals. Rate constants were calculated for gamma radiolysis of light and heavy water solutions. A G value for the solvated electron in both light and heavy water was determined. (B.L.M.)

23960 RADIOLYSIS OF WATER ADSORBED ON SILICA GEL. Krylova, Z. L.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). pp 133-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Data on the yields from gamma radiolysis of water adsorbed on silica-gel and the ESR spectra of silica-gel irradiated under conditions both with and without water present support the theory that high radiolytic yields (as much as 40 molecules/100 eV) are due to energy transfer from the silica-gel to the water. The purity and pretreatment of the silica-gel were found to have a profound influence on both the magnitude of the radiolytic yields and the products formed. (B.L.M.)

23961 RECENT WORK ON THE USE OF OXALIC ACID, IN AQUEOUS SOLUTIONS OR IN SOLID STATE, FOR CHEMICAL DOSIMETRY IN THE MULTI-MEGARAD REGION. Draganic, I. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 139-47 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radioinduced decomposition of aqueous solutions of oxalic acid over a certain concentration range, of solid oxalic acid, and of solid oxalates follows first-order reaction kinetics making them a suitable basis for chemical dosimetry. For aqueous solutions of oxalic acid, the decomposition rate decreases with increasing dose rate, and the decrease is more pronounced when the decomposition is higher than 30% of the initial concentration. The expression $D = \underline{a}\, C_0 \log C_0/C$, where D is the absorbed dose, $\underline{a}$ is a proportionality factor for a given set of irradiation conditions, C_0 is the initial concentration, and C is the concentration after irradiation was derived for the determination of absorbed doses of less than 100 MRAD. For absorbed doses between 100 and 1000 MRAD, a solid oxalic acid or ammonium oxalate dosimeter is proposed. The same expression for calculation of the absorbed dose is applicable to solid dosimeters if the proper value for $\underline{a}$ is used. The $\underline{a}$ values are given for γ and in-pile radiation for the aqueous solutions of oxalic acid, for solid oxalic acid, and for solid ammonium oxalate. (B.L.M.)

23962 TEMPERATURE EFFECTS IN THE X-RAY RADIOLYSIS OF FROZEN FRICKE SOLUTIONS. Kroh, J.; Czerwik, Z. (Polytechnical Inst., Lodz, Poland). pp 161-4 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The rate of Fe^{2+} oxidation in frozen Fricke solutions irradiated with 40-kV x rays was determined from −196 to −20°C. From −20 to −60°C, $G(Fe^{3+})$ decreased linearly with decreasing temperature; between −60 and −100°C, a very rapid decrease in $G(Fe^{3+})$ was noted; and below −100°C, the decrease again became moderate. It is probable that the rapid changes in $G(Fe^{3+})$ between −60 and −100°C are caused by structural transformations occurring in the frozen aqueous solutions and resulting in breaking of intermolecular hydrogen bonds and changes in the properties of the system in respect to the stabilizing of free radicals. (B.L.M.)

23963 RADIOLYTIC BEHAVIOR OF IRON IONS IN ACETYLENE AQUEOUS SOLUTIONS. Fiti, M. (Inst. for Atomic Physics, Bucharest). pp 165-73 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

In aqueous acetylene solutions containing iron ions, the change of the radiochemical yield and the nature of the radiolytic products were investigated as a function of the concentration of the solutes acetylene, Fe^{2+}, and O_2. The results obtained indicated that the presence of O_2 had a determining role in the mechanism of action of iron ions. In the absence of O_2, the results indicated a reduction of oxidation yield of Fe^{2+}, as well as inhibition of polymerization process. On the basis of known reactions of Fe^{2+} and the reaction proposed for the mechanism of radiolysis of acetylene in aqueous solutions, it was concluded that a competition between Fe^{2+} and acetylene for the radiolysis products of water takes place. Inhibition of the polymerization is explained simply by this competition of reactions, but a much more lengthy and complicated explanation involving an electron transfer process is presented for sensitizing of the oxidation process. (B.L.M.)

23964 EFFECT OF TEMPERATURE AND CONCENTRATION ON THE RADIOLYTIC REDUCTION OF AQUEOUS SOLUTIONS OF GOLD CHLORIDE. Koulkes-Pujo, A. M.; Rashkov, S. (Institut du Radium, Paris). pp 181-6 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Gold chloride in aqueous solutions was reduced by gamma radiation to the metallic state. The reduction yield at pH 2.8 and ambient temperature was 2.3 ± 0.2, and corresponded to a reduction of the gold by HO_2 radicals and H_2O_2 and to the oxidation of intermediate valencies by the OH radical. The radiolytic yield was found to be independent of the concentration of $AuCl_4^-$. The effect of temperature on the radiolytic yield was studied between 1 and 60°C. The yield increased slightly with increasing temperature up to 20°C. Above 20°C there was no temperature effect, and the yield was constant and equal to 2.3 ± 0.2. Several reaction schemes are proposed, and in every case it was concluded that the temperature effect arises from the reaction of auric ions with H_2O_2. (B.L.M.)

23965 REACTIVITY OF DIETHYL THALLIUM IONS WITH HYDRATED ELECTRONS. Sarrach, D. (Inst. for Applied Isotopic Research, Berlin). pp 197-201 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Irradiation of dilute aqueous solutions of dialkyl thallium salts with ^{60}Co γ rays was performed to investigate the radiation chemical behavior of this class of polyatomic compounds in aqueous solution and to prove its properties as scavengers for intermediates in water radiolysis. Results for diethyl thallium sulfate are reported. Chromatographic and polarographic analysis of the irradiated Tl compound indicated simple monovalent Tl ions to be the only Tl-containing radiation product. The radiolytic yields of deaerated and aerated solutions are presented in tabular form and show hydrocarbons to predominate in air-free solutions while considerable amounts of oxygenated products are formed in air-saturated samples. In deaerated solutions, $G(Tl^+)$ was only slightly influenced by the presence of acids; but in air-saturated solutions, the addition of H_2SO_4 decreased the yield of Tl^+. Saturation of the neutral solutions with N_2O diminished $G(Tl^+)$, and the value was further decreased by N_2O saturation of solutions of the compound that were 0.1M in methanol. From these results, schematic systems are prepared for the radiolytic decomposition of diethyl thallium sulfate. (B.L.M.)

23966 EFFECTS OF GAMMA RAYS ON AQUEOUS THIOCYANATE SOLUTIONS. Duflo, M. (Institut du Radium, Paris). pp 203-7 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Products resulting from the gamma radiolysis of aqueous solutions of thiocyanate at dose rates of 3 to 36×10^{18} eV cm^{-3} hr^{-1}

were measured as a function of pH, thiocyanate concentration, and presence of O_2 in order to determine the mechanism of radiolysis. In the radiolysis of aerated solutions, G values increase with thiocyanate concentration, and the initial G values depend on pH. The main products are cyanide, sulfate, and sulfur. In neutral deaerated solutions, the only sulfur compounds produced are sulfur and sulfate, while in acid solutions the only sulfur species was sulfide. Using chosen G values for the radiolysis of water, a reaction scheme is proposed that accounts for the experimental G values. However, the results obtained do not permit the precise calculation of G values for the decomposition of water. (B.L.M.)

23967 EFFECT OF THE PHASE STATE ON THE RADIOLYSIS OF ORGANIC SOLIDS. Ermolaev, V. K.; Voevodskii, V. V. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). pp 211-23 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The irradiation of ethylene glycol, glycerol, glucose, and sucrose was carried out in an ESR cavity by 3×10^5-eV electrons at temperatures of 77 and 260°K. The ESR spectra of the substances are presented, and all substances except ethylene glycol and amorphous glycerol exhibited irreversible changes in the spectra on raising the temperature. These changes in spectra are accompanied by partial recombination of the radicals. A comparative study of radical yields for the crystalline and amorphous substances at 100 to 120°K was made, and the phase state was found to have considerable effect on the primary radiolytic process as manifested in the yields and the nature of free radicals formed. At 77°K the major radical formed by the radiolysis of crystalline glycerol is $CH_2OH-COH-CH_2OH$ and of crystalline carbohydrates is of the type $X-CH-Y$. The major radicals in the irradiated amorphous substances are of the type RO, and all the amorphous samples assumed an intensive red color during irradiation while the crystalline samples remained white. This irradiation coloring and the formation of radicals, which are due to the participation of the polar groups of the molecules in the reaction, make a heterolytic mechanism for the radiolysis process highly probable. The data for the effect of H_2O concentration dependence of the radical yield for radiolysis of glycerol–water mixtures at 110°K confirmed the idea that the contribution by the heterolytic reactions will depend on the concentration and nature of the structural defects capable of charge localization leading to increase in the lifetime of the resulting ions. (B.L.M.)

23968 FORMATION OF UNIVALENT SULFUR RADICALS IN ORGANIC GLASSES AT –196°C. Wendenburg, J. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 225-32 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Organic disulfides, mercaptans, and sulfides in glasses of MTHF were exposed to γ radiation at –196°C, and the reactions of the disulfides were studied in the gas phase. The optical density of the solvated electron in the condensed phase for the various systems is presented in graphical form as is the effect of the concentration on the extinction coefficient for the different systems. The reactions of H_2S, disulfides, and mercaptans with slow electrons in the gas phase are presented in tabular form along with the values for the appearance potential and the cross section. The effects of CCl_4, an electron capturer, on the absorption spectra of the irradiated substances were determined. (B.L.M.)

23969 FREE RADICALS IN GAMMA IRRADIATED IMIDAZOLE. Lamotte, B.; Servoz-Gavin, P. (CEN, Grenoble, France). pp 233-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Single crystals of imidazole were γ irradiated at room temperature and at 77°K, and the ESR spectra were recorded. The spectrum for the sample irradiated at room temperature showed three principal bands with respective intensities of 1 : 2 : 1 with a splitting of 47 G arising from two equivalent protons. For certain orientations, each of these bands reveals simple, well resolved structures. For the resolved orientations, the couplings with the two nitrogens were observed to be equivalent, and the coupling constants vary from nearly 0 to about 11 G. In some orientations, couplings with protons at positions (1) (4) (5) were noted, and the coupling constants increased from small values giving unresolved lines of a width difficult to measure up to about 9.2 to 11 G. Neither a complete coupling tensor and its principal direction nor the precise attribution of the couplings with the (1) (4) (5) proton were determined, but a model of the radical is proposed. The ESR spectra of single crystals irradiated at 77°K are consistent with a 1 : 2 : 3 : 3 : 3 : 3 : 2 : 1 intensity distribution, which gives a strong coupling constant with one proton of 32 G and with two equivalent nitrogens of about 10.2 G. It was concluded that the primary radical is formed by removal of the imino-group H, i.e., the labile hydrogen bonded proton, but the electronic configuration of the radical is still uncertain. (B.L.M.)

23970 HYDROGEN FORMATION IN THE RADIOLYSIS OF LIQUID METHANOL. Teply, J.; Habersbergerova, A. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). pp 239-45 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

In the radiolysis of liquid methanol, kinetics of the reactions of the hydrogen precursors, solvated electrons, hydrogen atoms, and the unscavengeable molecular hydrogen with some solutes were analyzed and their yields calculated. The hydrogen precursors were formed in the physicochemical stage of radiolysis, and their reactions in pure methanol and in the presence of solutes are reported. The solutes N_2O, O_2, I_2, and $FeCl_3$ are considered. The hydrogen yields reported by various authors for the system are compared. The different values reported for yields of electrons are practically identical and ≅1.1. The yields of "unscavengeable" hydrogen fluctuate around 1.6 and depend somewhat on the scavenger used. (B.L.M.)

23971 RADIOLYSIS OF GLASSY METHANOL AND n-PROPANOL AT 77°K. Dainton, F. S.; Salmon, G. A.; Wardman, P.; Zucker, U. (Univ. of Leeds, Eng.). pp 247-56 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The spectra of γ-irradiated methanol and *n*-propanol glasses at 77°K are reported along with the G values and the molar extinction coefficients. The yield of trapped electrons in the methanol glass was determined by the addition of tetranitromethane as an electron and radical scavenger. The product yields from the glassy methanol were found to vary with the warming procedure, the reaction schemes are suggested based on the products identified. Illumination of either of the irradiated glasses with green light caused the E band to decrease while the R band remained constant. Some quantitative measurements of the rate of photobleaching of the E band of *n*-propanol glass are reported. The ESR spectra of the γ-irradiated *n*-propanol contains two components, a central singlet and a 5 line spectrum, which is attributable to the radical CH_3CH_2CHOH. (B.L.M.)

23972 RADIOLYSIS OF ISOPROPANOL IN GLASSY STATE. Kiss, F.; Bagdasaryan, Kh. S. (Karpov Inst. of Physical Chemistry, Moscow). pp 257-64 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radiolysis of isopropanol and solutions of benzophenone in 2-propanol at 77°K was performed using dose rates from a ^{60}Co source of 0.65×10^{18} to 2×10^{18} eV/g/min. Analysis of the gaseous products, acetone, methane, and hydrogen, was performed by gas chromatography. The optical and ESR spectra of the glassy propanol indicated the formation of solvated electrons and hydroxy 2-propyl radicals. In the presence of benzophenone, ketyl radicals and anion-radicals of benzophenone are formed. In the radiolysis of 2-propanol, the yield of acetone in both the glassy and liquid state was dependent on the concentration of the benzophenone. (B.L.M.)

23973 RADIOLYSIS OF t-BUTYL HYDROPEROXIDE. Verdin, D. (Atomic Energy Research Establishment, Wantage, Eng.). pp 265-73 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The gamma-induced decomposition of pure liquid tert-butyl hydroperoxide (TBHP) was examined at 20°C by analysis of the products formed and by the measurement of the loss of TBHP by iodimetric titration. The gaseous product was predominantly O_2 with small amounts of H_2, CH_4, C_2H_4, C_2H_6, CO, and isobutene. The liquid products, in order of decreasing G value, were tert-butanol, water, di-tert-butyl peroxide, acetone, and methyl tert-butyl ether. The effect of dose rate on TBHP decomposition and on the yield of each of the radiolysis products was measured, and the results are summarized. A reaction mechanism is suggested that accounts for the general features of the radiolysis, but the influence of temperature and the addition of radical and electron scavengers are not considered. (B.L.M.)

23974 RADICAL REACTIONS AND RADIOTHERMOLUMINESCENCE PHENOMENA IN ORGANIC GLASSES IRRADIATED AT –196°C. Kosa-Somogyi, I.; Gecs, M.; Vizesy, M. (Central Research Inst. of Physics, Budapest). pp 275-84 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The movements and reactions of charged particles produced by high-energy radiation in organic glasses at –196°C were inferred

from measured values of the luminescence and electric conductivity and the ESR spectra. The results obtained on methylcellosolve (MCS) are reported in detail while the results of similar measurements performed on methanol and α-methyltetrahydrofuran are reported only briefly. G values for radical formation and for trapped electron formation are calculated, and reaction schemes are proposed. (B.L.M.)

23975 RADIATION CHEMICAL TRANSFORMATION OF THIOLS AND THIOCYANATES. Nanobashvili, E. M.; Tchirakadze, G. G.; Simonidze, M. Sh.; Ivanitskaya, L. V.; Panchvidze, M. V.; Barsegov, R. G. (Inst. of Applied Chemistry and Electrochemistry, Tbilisi, USSR). pp 285-93 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The mechanism of radiation-chemical transformation and the primary process during transformation of the thiols and thiocyanates were studied for aliphatic and aromatic thiols and for KCNS and NH_4CNS both alone and in various solvents. The data on low temperature (77°K) radiolysis of the thiols obtained by ESR measurements indicated that in the initial stage the conversion of thiols proceeds through the thiol radical; and the yield of thiol transformation depends upon dose rate, nature of solvent, and temperature. A simplified reaction scheme for the transformation of thiophenol is presented; but it is assumed that in concentrated solutions of thiols in benzene, isooctane, and other solvents radiation-chemical transformation has a complex mechanism involving both radiation-chemical and chemical processes, and no attempt is made to suggest a specific mechanism. The transformation of thiocyanates was studied in x and γ radiolysis of dilute acetic acid and acetone solutions of the two thiocyanates. The decomposition of the thiocyanates passes through several stages with the final stage leading to the formation of sulfate and thiocyanates. The initial oxidation of the thiocyanates in organic solvents may be attributed to interaction between the initial radiolytic products of the solvent and the thiocyanate ion resulting in the formation of the thiocyanate radicals, which under certain experimental conditions could be identified by ESR methods. (B.L.M.)

23976 FORMATION AND CONVERSION OF PEROXIDES IN RADIATION-INDUCED OXIDATION OF HYDROCARBONS. Saraeva, V. V.; Bach, N. A.; Romantsev, M. F. (Moscow State Univ.). pp 311-18 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

At comparatively low doses and sufficiently high oxygen concentrations, the peroxide compounds formed by the radioinduced oxidation of hydrocarbons are all accounted for by hydroperoxides. However, further irradiation results in the formation of new peroxide compounds, and from polarographic data it was concluded that the second peroxide compounds are dialkyl peroxides containing alkyl groups with a large number of C atoms. In order to illucidate the mechanism of the formation of these dialkyl peroxides, the radiolysis of hydroperoxides in hydrocarbon solutions in the absence of O_2 and the competitive reactions of hydroperoxide formation and conversion were investigated. Reaction mechanisms are proposed for the total irradiation picture, and a kinetic analysis of the experimental data is presented. (B.L.M.)

23977 RADIOLYSIS OF POLYNUCLEAR ISOLATED HYDROCARBONS. Kules, I.; Gecs, M. (Central Research Inst. of Physics, Budapest). pp 319-25 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

In order to get a better insight into the problem of radiation chemical protection, the in-pile and γ-induced radiolysis of polynuclear isolated hydrocarbons was studied. The radiolytic yields of both gaseous and polymeric products are presented. From the results obtained, it was concluded that α, ω-diphenylalkane compounds exhibit decreasing LET effect and decreasing protective effect with increasing chain length, and from the aspect of protection, the ring-ring interactions seem to play an important part. (B.L.M.)

23978 GAMMA RADIOLYSIS OF SOME N-HETEROCYCLIC COMPOUNDS. Lahmani, F.; Ivanoff, N. (Faculte des Sciences, Orsay, France). pp 327-31 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The yield of gaseous products from the radiolysis of liquid para-, meta-, and ortho-diazines was low, but it increased from para- to meta- to ortho-diazine. The polymeric product yields for the diazines are relatively high in comparison with benzene. The G values are tabulated for both the gaseous and polymeric product yields. From the radiolytic product yield, it was concluded that the primary reaction in the para-isomer is the rupture of C–H bond. In the case of ortho- and meta-diazine, the ring breakage is rather important, but some C–H bond rupture takes place. The G values for radical formation was determined by irradiating the bases in the presence of radical scavengers. The photolysis of the compounds in the liquid state under O_2-free conditions was determined. (B.L.M.)

23979 SOME ASPECTS OF THE PULSE RADIOLYSIS OF SOLUTIONS OF NAPHTHALENE AND ANTHRACENE IN EITHER CYCLOHEXANE OR BENZENE. Kemp, T. J. (Univ. of Warwick, Coventry, Eng.); Roberts, J. P.; Salmon, G. A.; Thompson, G. F. pp 333-44 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Mechanisms proposed to account for the production of the triplet states resulting from the pulse radiolysis of a solute such as naphthalene, anthracene, or biphenyl in solvents including aliphatic or aromatic hydrocarbons, acetone, or certain ethers are reviewed. Experiments were performed to gauge the relative importance of certain of the mechanisms. It was concluded from results of the experiments that mechanisms involving a singlet excitation transfer mechanism predominate for the alkanes, but for the aromatic solvents, the triplet state of the solvent may be involved as well as the singlet states. (B.L.M.)

23980 CLASSIFICATION OF MONOSUBSTITUTED BENZENES AS SCAVENGERS IN THE GAMMA-RADIOLYSIS OF LIQUID CYCLOHEXANE. Schulte-Frohlinde, D. S.; Bergdolt, A. (Kernforschungszentrum, Karlsruhe, Ger.). pp 345-51 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

In order to investigate the influence of aromatic substitution on electron scavenging in liquid hydrocarbons, the hydrogen yields from mixtures of cyclohexane with some monosubstituted aromatic compounds were measured. On the basis of their effects on the yield of hydrogen from the γ radiolysis of cyclohexane, the monosubstituted benzenes used as solvents may be divided into two groups; those substituted with a halogen or an electron-accepting group, and those substituted with an electron-donating substitute. The compounds of the first group showed better electron-scavenging effects than the other group. The addition of N_2O to the two groups of solutes in cyclohexane substantiated the conclusion that the first group of compounds were acting as electron scavengers since only the compounds of the first group were able to undergo competitive reactions with the N_2O. (B.L.M.)

23981 RADIOLYTIC OXIDATION OF METHANE. Hummel, R. W.; Hearne, J. A. (Atomic Energy Research Establishment, Wantage, Eng.). pp 353-64 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Mixtures of CH_4 containing 10 vol % O_2 were γ-irradiated in a study to determine the initial G values of the products formed. Initial G values of 13 oxygenated and 4 hydrocarbon products are tabulated. The major oxygenated products are CH_3OOH, CH_2O, CH_3OH, and C_2H_5OH, and C_2H_4 is the main hydrocarbon product. This discussion of the experimental results is based on the idea that radiolysis leads mainly to the formation of CH_3, H, and O, all of which react preferentially with O_2 to give CH_3O_2, HO_2, and O_3. Subsequent reactions of the last mentioned species give rise to the products identified. Suggested reactions for the formation of the intermediate species and the final products are presented. (B.L.M.)

23982 RADIATION CHLORINATION OF CHLOROPENTANES. Lebedev, D. D.; Vereshchinskii, I. V. (Karpov Inst. of Physical Chemistry, Moscow). pp 365-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effects of temperature and dose rate on the γ-induced chlorination of 1,1,1,5-tetrachloropentane were investigated. A chain reaction mechanism is suggested to explain the formation of the identified products, penta-, hexa-, hepta-, octa-, nona-, and decachloropentanes. Rate constants were calculated for some chloropentanes at different temperatures, and the dependence of the radiation chemical yield of polychloropentanes on the dose rate was calculated and tabulated. (B.L.M.)

23983 RADIOLYSIS OF TERNARY ORGANIC MIXTURES. Urban, J.; Bednar, J. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). pp 371-80 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The γ radiolysis of mixtures of liquid C_6H_6, CCl_4, and cyclohexane were studied over a wide concentration range. Twenty reactions are suggested that may take place to yield H_2 and HCl as final products. Curves showing the yields of H_2 and HCl as

a function of concentration of the different components of the mixture are shown, and G values are calculated. (B.L.M.)

23984 RADIATION CHEMICAL INVESTIGATIONS OF ALKANE–ALKENE MIXTURES. Foeldiak, G.; Cserep, G.; Stenger, V. (Hungarian Inst. of Isotopes, Budapest). pp 381-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effects of β, γ, and in-pile radiation at room temperatures on several alkane-alkene mixtures were determined. Figures are presented showing radiation chemical yield ($H_2 + CH_4$) as a function of the concentration of one of the components of the system. Some conclusions are drawn concerning the influence of saturated or unsaturated components of the mixture on the radiation yield. The effects of irradiation conditions are also considered. (B.L.M.)

23985 RADIOLYSIS OF SOME HYDROPARATERPHENYLS. Kiss, I.; Pinter, K.; Roder, M. (Central Research Inst. of Physics, Budapest). pp 391-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radition chemistry of some partially hydrated para–terphenyls was investigated with respect to the effects of stereoisomerism, degree of saturation, and phase change. The samples were irradiated at temperatures from 20 to 230°C with γ and in-pile radiation. Both saturated and unsaturated compounds showed an inverse dependence of gas yield on dose, but the polymeric yield was independent of dose. The composition of the gas yield made up of H_2, CH_4, and hydrocarbons was independent of dose. The H_2 yield was found to increase with increasing temperature for all the compounds studied; however, the rate of increase was not the same for all compounds. The H_2 yield did not change appreciably at temperatures corresponding to the phase change for the compounds. The effect of temperature on polymeric yield was similar to that for H_2, but the gaseous hydrocarbon yields were appreciably affected by phase change. (B.L.M.)

23986 RADIATION INDUCED CHAIN OXIDATION OF BENZENE TO PHENOL IN AQUEOUS SOLUTIONS OF FERROUS IONS AND OXYGEN. Kartasheva, L. I.; Pikaev, A. K. (Inst. of Physical Chemistry, Academy of Sciences, USSR). pp 399-408 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

High radiolytic yields of Fe^{3+}, C_6H_5OH, and $C_6H_6O_2$ were measured after γ and electron irradiation of aerated sulfuric acid solutions of benzene containing Fe^{2+} ions, and the high yields were interpreted as positive evidence of a chain process in the system. Suggested mechanisms for the chain process are presented, and a detailed kinetic analysis of the possible reactions is shown. (B.L.M.)

23987 RADIATION INDUCED OXIDATION OF CERTAIN PETROLEUM FRACTIONS INITIATED BY WATER EMULSION OF THEIR RADIOLYSIS PRODUCTS. Minc, S.; Bryl-Sandelewska, T.; Nowak, Z.; Wincel, H.; Stachowicz, W.; Kecki, Z. (Inst. of Nuclear Research, Warsaw). pp 409-16 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radiation yields of peroxides in emulsions and nonemulsion systems of a given petroleum fraction boiling between 290 and 320°C and containing 43% aliphatic hydrocarbons, 55% naphthalanic hydrocarbons, and 2% aromatic hydrocarbons are compared. The yield of oxidation products (peroxides, acids, and carbonyl compounds) produced by the addition of the products from γ radiolysis of the fraction and its water fraction are presented. The peroxide yields of the water emulsion were several times higher than the yields in the anhydrous system, and the yield increased with increasing absorbed radiation dose and temperature of irradiation. (B.L.M.)

23988 ELEMENTARY RADIATION-CHEMICAL PROCESSES OF TETRAHYDRONAPHTHALENE AS STUDIED BY MASS SPECTROMETRY. Wincel, H.; Kecki, Z.; Minc, S. (Inst. of Nuclear Research, Warsaw). pp 417-22 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The elementary radiation-chemical processes of 1,2,3,4-tetrahydronaphthalene (THN), which combines the characteristics of both aromatic and alicyclic compounds, were studied after electron irradiation. The data indicated that the THN decomposition under electron impact occurs in a series of parallel consecutive reactions. On the basis of the activation energies of the reactions as determined by mass spectrometry, the estimated values of frequency factors, and the experimentally obtained degrees of freedom, the rate constants of the primary reactions with an energy between 0 and 30 eV were computed. Calculated yields of individual molecular products formed in the elementary radiation-chemical process occurring in liquid THN are tabulated and compared with experimental data for several proximate points. (B.L.M.)

23989 INFRARED EXAMINATION OF THE PRODUCTS APPEARING IN RADIATION INDUCED OXIDATION OF PETROLEUM. Stachowicz, W.; Kecki, Z.; Minc, S. (Inst. of Nuclear Research, Warsaw). pp 423-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The infrared spectra of samples of products resulting from the oxidation of a petroleum fraction both by the addition of a small amount of the fraction previously irradiated and by the addition of a small amount of a previously irradiated water emulsion of the petroleum sample are reported. Comparison of the spectra of the two type mixtures showed a marked difference in products. If a water-emulsion mixture is used to initiate oxidation, the products contain a higher percentage of acids, but if the pure irradiated substrate is added, the alcohol yield is much higher. (B.L.M.)

23990 RADIOLYSIS OF THYMOLSULFONPHTHALEIN IN THE SYSTEM RH–ETHANOL–CHLOROBENZENE. THE EFFECT OF SOME IONIC ADDITIVES. Zec, U.; Dvornik, I.; Ranogajec, F. (Inst. Ruder Boskovic, Zagreb). pp 429-35 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

A study was made of the γ radiolysis of thymolsulfonphthalein (TSF) in systems of the type RH-10% ethanol-chlorobenzene-TSF-air, where RH is toluene or isooctane, to obtain systematic data about the influence of system composition on the yields of TSF destruction. All samples were measured as irradiated, and then a second measurement was made in the presence of HCl or KOH. G values for the system under various conditions were calculated, and some conclusions drawn as to what the reactive species and the final products must be. Some observations were made on the degassed systems, but the phenomena were too complex for any conclusions to be drawn. (B.L.M.)

23991 RADIOLUMINESCENCE IN BENZENE–METHANOL MIXTURES (MECHANISM OF THE QUENCHING EFFICIENCY OF METHANOL). Spurny, Z.; Spurny, F. (Inst. of Nuclear Research, Prague. Faculty of Nuclear Physics, Prague). pp 437-41 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Methanol quenching of the radioluminescence of dilute air-equilibrated benzene-scintillator solutions excited both under high-energy ^{60}Co γ rays and 3100 Å uv light was investigated. The results were obtained with two scintillators: 2,5-diphenyl-1,3-oxazole (PPO) and 2-phenyl-5,4-biphenyl-1,3,4-oxadiazole (PBD). The data indicated that the quenching ability of the methanol is probably due to its OH group. The H atom of this group can receive an electric charge and produce a slight H-bonding with some aromatic compounds to prevent radiation transfer of the excitation energy from benzene to the scintillator. (B.L.M.)

23992 RADIOLYTIC FORMATION OF POLYMERS FROM MIXTURES OF HEXAFLUOROBENZENE WITH PERFLUOROCYCLOHEXENE AND PERFLUORONONANE. Khramchenkov, V. A. pp 443-7 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effect of variation of concentration of hexafluorobenzene on the neutron- and γ-induced polymeric yields in mixtures of hexafluorobenzene with perfluorocyclohexane and perfluorononane was evaluated. The polymeric yield from the mixtures of hexafluorobenzene with n-perfluorononane exceeded the yield obtained from either of the components and led to the conclusion that hexafluorobenzene is an agent stimulating polymerization. However, mixtures of hexafluorobenzene with perfluorohexane exhibited a decreasing polymeric yield with increasing electron fraction of the latter, and the yields were considerably below expected theoretical values. No conclusions were drawn concerning the mechanisms of these polymerizations. (B.L.M.)

23993 RADICAL AND IONIC SPECIES IN RADIATION-INDUCED POLYMERIZATION. [illegible]ashi, K.; Yamaoka, H.; Okamura, S. (Kyoto Univ.). pp 451-62 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Several different approaches to the problem of the determination of the active species in radioinduced polymerization mainly in the liquid phase are discussed. Activation analysis of polystyrene formed in $CHCl_3$ was used to determine the Cl content of the terminal group. Recent developments in ionic polymerization at low temperatures are reviewed with some data on styrene polymeriza-

tion being tabulated. Pertinent findings previously reported for both cationic and anionic polymerization of very dry monomers are cited. A brief discussion of the polymerization of cyclic ethers in the solid state is included. (33 references). (B.L.M.)

23994 MECHANISM OF RADIATION ANIONIC POLYMERIZATION. Abkin, A. D.; Sheinker, A. P.; Tolstoukhova, L. P. (Karpov Inst. of Physical Chemistry, Moscow). pp 463-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Some peculiarities of radiation anionic polymerization are considered on the basis of some kinetic data. An expression was derived for the overall rate of radioinduced copolymerization of a two monomer system, such as acrylonitrile and methylmethacrylate in triethylamine solution, and the calculated values agreed well with the experimental value for the copolymerization at –78°C. From the data, it is proposed that the anionic polymerization induced by the radiation could involve a two-step initiation reaction first the formation of a free radical followed by the capture of an electron. (B.L.M.)

23995 POLYMERIZATION OF STYRENE AND α-METHYLSTYRENE BY IRRADIATION WITH SHORT PULSES OF FAST ELECTRONS. Schneider, Ch.; Swallow, A. J. (Univ., Cologne. Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 471-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The polymerization of styrene and α-methylstyrene by irradiation with short pulses of fast electrons was studied in both the pure state and in solutions. Absorption spectra were recorded. The kinetics of the decay of various intermediate species are discussed, and some attempts are made to establish identity of the intermediates and the role they play in the polymerization scheme. (B.L.M.)

23996 INFLUENCE OF TRIPHENYL-BETA-STYRYL-METHANE AND TRIMETHYL-BETA-STYRYL-LEAD ON THE POLYMERIZATION OF STYRENE. Danielczyk, B.; Orszagh, A. (Univ. of Warsaw). pp 479-82 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

In order to obtain some information on the role of the metal atom in the reactivity of metalloörganic compounds, a comparison was made of the behavior of triphenyl-β-styryl-lead (T-Pb) and the nonmetallic analog triphenyl-β-styryl-methane (T-Met) in the process of polymerization of styrene induced by γ radiation and by chemical initiators. Both with radioinduced and chemically initiated polymerization, T-Pb markedly accelerated the polymerization while T-Met had an inhibiting effect. Benzoyl peroxide was used as a chemical initiator. The accelerating effect of T-Pb is explained by the fact that the free radicals from the compound initiate additional chain growth. The inhibiting effect of T-Met is attributed to the inability of this substance to form chains due to steric hinderance caused by the presence of large aromatic substitutents and to its stability to radiation with no radiolysis products being formed. (B.L.M.)

23997 EFFECT OF COMPLEXING AGENTS ON THE POLYMERIZATION OF ALLYLIC MONOMERS. Kulikova, V. F.; Savinova, I. V.; Zubov, V. P.; Kabanov, V. A.; Polak, C. S.; Kargin, V. A. (Moscow State Univ. Petrochemical Inst., Moscow). pp 493-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The γ-induced polymerization of allyl acetate and allyl alcohol was greatly enhanced by the addition of $ZnCl_2$. In both cases, the rate of polymerization depended approximately on the first power of the dose rate and very little on the temperature. The physiochemical properties of the polymers changed considerably with $ZnCl_2$ concentration and dose. A polymerization mechanism is suggested that may involve a complexed monomer. Thus the increase of polymerization could be connected with the decrease of probability of degradational chain transfer with the complexed monomer molecule. It is also possible that the complexed allyl radicals produced by chain transfer are so much activated as to become able to open the double bond of the monomer molecule. (B.L.M.)

23998 GAMMA-RAY INDUCED COPOLYMERIZATION OF ETHYLENE AND CARBON MONOXIDE. Munari, S.; Russo, S.; Rossi, C. (Univ., Genoa). pp 501-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The established technique of γ-induced copolymerization of ethylene and CO at room temperature was applied to very pure monomers in a study to clarify the kinetic features of the process. The addition of CO to ethylene greatly increased the polymer yield in the virtual absence of O_2; however, even at low concentrations the presence of O_2 inhibited the ethylene polymerization. An overall kinetic scheme is suggested for the copolymerization process. (B.L.M.)

23999 RADIATION POLYMERIZATION AND COPOLYMERIZATION OF VINYL FLUORIDE. Usmanov, Kh. U.; Yulchibaev, A. A.; Dordyain, G. S.; Yuldasheva, Kh. (Tashkent State Univ.). pp 511-17 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

A high radiation-chemical yield dependent on γ dose rate was measured for vinyl fluoride polymerization. The yield ranged from 0.5 to 4.5×10^4 molecules/100 eV, and an expression is given relating yield to dose rate. The data indicate that chain polymerization termination does not take place by chain transfer at all. The inhibiting effect of various concentrations of acetylene and O_2 on the polymerization was investigated. The polymerization rate in solutions of benzene and CCl_4 was considerably lower than in the pure state. The copolymerization of vinyl fluoride with vinyl chloride, vinyl acetate, and acrylonitrile was studied at various dose rates. Results of studies of the important properties of the polymers and copolymers are presented. (B.L.M.)

24000 RADIATION INDUCED POLYMERIZATION OF FLUORO OLEFINES. Volkova, E. V.; Zimakov, P. V.; Fokin, A. V. pp 519-26 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radioinduced polymerization of tetrafluoroethylene, trifluoroethylene, trifluorochloroethylene, vinylidene fluoride, vinyl fluoride, hexafluoropropylene, and perfluoroisobutylene were studied in the liquid phase at a dose rate of 10 RAD/sec at 20°C, except for the tetrafluoroethylene studies which were carried out at –78°C. A radiation chemical yield as high as 10^6 molecules/100 eV was noted for polymerization of tetrafluoroethylene, and the extraordinary high rate of polymerization is associated with the influence of the fluorine atom. Substitution of H for the F led to a decrease of polymerization rate, as did the substitution of a Cl atom for a F atom. From the experimental data, the fluoro olefins are arranged in the following series according to the decrease in polymerization rate: $CF_2 = CF_2 > CF_2 = CFH > CF_2 = CH_2 > CFH = CH_2 > CF_2 = CFCl > CF_2 = CF-CF_3 > CF_2 = C\begin{smallmatrix}CF_3\\CF_3\end{smallmatrix}$.

The results of kinetic studies showed that the kinetics of the radioinduced polymerization process are more complex than the kinetics of chemical polymerization. (B.L.M.)

24001 RADIATION INDUCED COPOLYMERIZATION OF METHACRYLIC ACID WITH METHACRYLAMIDE. Mousaev, U. N.; Tillaev, R. S.; Usmanov, Kh. U. (Tashkent State Univ.). pp 527-33 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The γ-induced polymerization of methacrylic acid and methacrylamide in water solutions was studied at radiation doses and intensity varied over a wide range and at various concentrations of monomer solutions. An increase in either irradiation dose or concentration of initial monomer solution were found to result in increased polymerization. Various characteristics and properties of the copolymers were investigated. The relation of characteristics of the copolymer to conditions of its formation are discussed. (B.L.M.)

24002 PREPARATION OF THERMALLY STABLE COPOLYMERS OF POLYFORMALDEHYDE BY IONIZING RADIATION. Hodkevich, L. (Inst. of Chemical Industry, Sofia). pp 535-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Probable mechanisms are proposed for the formation of radicals by irradiation of polyformaldehyde (PFA), which can account for the formation of block-, graft-, and inter-polymers. The depolymerization of the PFA with propylene oxide, styrene, and methyl methacrylate as monomers was induced by γ irradiation. The relative viscosity before and after irradiation, the melting point, the yield, and the kinetic curves of the decomposition of the copolymer at 232°C in air were all studied. On the basis of the experimental results it was assumed that on irradiation of the PFA in the presence of monomers, cleavage of the chain occurs with formation of block polymers. (B.L.M.)

24003 ELECTRON MICROSCOPIC STUDY OF SOLID PHASE POLYMERIZATION. Azori, M.; Plate, N. A.; Kargin, V. A. (Central Research Inst. of Chemistry, Budapest. Moscow State Univ.). pp 547-56 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

A method is described for following the polymerization process of monomers in single crystals by electron microscopy. The polymerization was carried out directly in the electron beam, and the temperature and dose dependence of polymerization was investigated. Some polymerization processes induced by γ radiation were studied by irradiating the crystals prior to the electron microscopic examination. The following monomers with fairly high melting points were used: N-phenylmethacrylamide, N-p-phenylmethacrylamide, dimethylacrylamide, and N-phenyldimethylacrylamide. The direct electron microscopic observation of the process showed that simultaneously with the polymerization reaction fibrous supermolecular structures are formed. In most cases the positions of these bundles are not random but oriented in a certain crystallographic direction of the original monomer crystal. Two basically different structures were observed for the different monomers, and these are described in detail. (B.L.M.)

24004 KINETICS OF THE SOLID STATE POLYMERIZATION OF N-VINYL CARBAZOLE. Tudos, F.; Boros-Gyevi, E. (Central Research Inst. of Chemistry, Budapest). pp 557-72 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Expressions were obtained for the γ-induced polymerization rate both during the induction period when the polymer of N-vinylcarbazole forms at a slow constant rate and during the second period when autocatalysis is the dominating process. The kinetics of the degree of polymerization are discussed in detail as is the mechanism of polymerization. (B.L.M.)

24005 RADIATION INDUCED POLYMERIZATION OF N-VINYL PYRROLIDONE IN THE SOLID STATE. Munari, S.; Tealdo, G.; Vigo, F.; Bonta, G. (Univ., Genoa). pp 573-81 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The gamma-induced polymerization of N-vinylpyrrolidone was studied in both the solid and liquid state. The rate of polymerization in the solid state increased after several hours to a value comparable with the values in the liquid phase. The rate was found to be dependent on temperature, but polymerization in neither phase was a simple function of dose rate. The initially low polymerization rate in the solid state followed by a rapid acceleration after some time was due to the following factors: crystalline structure of the monomer, increase of the sample temperature during irradiation, the role of the preformed polymer, and volume contraction during polymerization. (B.L.M.)

24006 KINETICS OF RADIATION INDUCED SOLID STATE POLYMERIZATION OF N-SUBSTITUTED ACRYLAMIDES. Orszagh, A.; Zurakowska-Orszagh, J. (Univ. of Warsaw). pp 583-92 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

A series of monomers ranging from acrylamide to N-tert-nonylacrylamide with comparatively large substituents and having the general formula $H_2C=CH-\overset{O}{\overset{\|}{C}}-NH-\overset{R_1}{\overset{|}{C}}-R_2$, where R_1, R_2, and R_3 are various alkyl groups, were irradiated with ^{60}Co γ radiation to study the effect of gradual structural change of the monomers on their ability to polymerize in the solid state. Remarkable differences were noted in the polymerization rates of the different monomers. From the kinetics of the radioinduced solid-state polymerization, a general curve was obtained that would fit the kinetics of any of the monomers. That this remarkable similarity in polymerization mechanism is due to quantitative rather than qualitative differences between the monomers is offered as an explanation for the one expression describing the kinetic curves of the series of monomers. (B.L.M.)

24007 MECHANISM OF SOLID PHASE POLYMERIZATION. Barkalov, I. M.; Benderskii, V. A.; Goldanskii, V. I. (Inst. of Chemical Physics, Moscow). pp 593-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The mechanisms of solid-phase polymerization is discussed from three aspects: polymerization in "hot" zones, polymerization in absence of "hot" zones, and photopolymerization and post effects. A schematic diagram is proposed for polymerization in the the "hot" zone. Two separate steps are proposed for polymerization in the absence of "hot" zone: transfer of electron energy to the active center to initiate polymerization and subsequent growth of polymer molecules from monomers with equilibrium distances between the monomer links. (B.L.M.)

24008 RADIATION INDUCED ELECTRICAL CONDUCTIVITY DURING SOLID STATE POLYMERIZATION. Hedvig, P. (Plastics Research Inst., Budapest). pp 599-606 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Current change during the course of radioinduced solid-state polymerization was investigated by two methods: dc current method and the pulse method. In the dc current method, a constant dc voltage is applied to the sample after gamma irradiation to compensate the dark current flowing across the sample. A certain correlation was observed between the induced currents and polymerization. However, two difficulties were noted in correlating the equilibrium currents to polymerization. First, the monomer is a poor heat conductor, and the actual temperature of the sample changes continuously during the course of the irradiation. Second, the induced currents are dependent on the change of physical structure of the material and on the concentration of the free radicals formed by the irradiation. In order to ensure adiabatic conditions for the charge carriers, x-ray pulses were used. An expression is given for the dose-rate dependence of the induced current pulses. The data indicate that trapping centers formed during the course of the polymerization reaction disappears on prolonged storage. The charge-carrier mobilities were found to be not much affected by structural changes during the polymerization process. (B.L.M.)

24009 RADIATION INDUCED POLYMERIZATION AND COPOLYMERIZATION OF SOME NORBORNENE DERIVATIVES. Hardy, Gy.; Nyitrai, K. (Research Inst. for Plastics, Budapest). pp 613-20 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The γ-induced polymerization and copolymerization of the unsaturated cyclics, 5-carboxy-bicyclo-(2,2,1)-heptene-(2) (norbornenecarboxylic acid), norbornenedicarboxylic acid monoallyl ether, and norbornene dicarboxylic acid monopropyl ester were investigated in the liquid state at 65, 55, and 46.5°C with dose rates between 0.49 and 1.05×10^5 R/hr. The kinetics are of a linear character; the polymerization rate is proportional to the first power of the dose rate; and the polymerization is inhibited by the addition of certain chemicals. From spectroscopic analysis, it was concluded that carboxylic acid polymerizes by opening of the ring but with preservation of the double bonds. The monopropyl ester does not polymerize in the solid state but forms a solid solution with the allyl ester and reduces the polymerization rate of the latter by physical hindrance. (B.L.M.)

24010 RADIATION POLYMERIZATION OF THE NON-ISOMORPHOUS SYSTEM OF ACRYLAMIDE–CARBAMIDE. Kiss, L.; Polgar, S.; Grell, M.; Barkaszi, B. (Research Inst. for Plastics, Budapest). pp 621-32 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The phase diagram of the system acrylamide-carbamide showed two eutectic points at 64 and 77.5 mole % acrylamide. A molecular compound is formed at 73 mole % acrylamide. The γ-induced polymerization of the nonisomorphous system proceeds at low temperatures (–16 and –78°C) at which pure acrylamide does not polymerize. The polymerization reaches a maximum at the eutectic point and a minimum where the molecular compound is formed. Microphotographs of the two-component system and of both pure components are shown. The effects of crystal structure on the polymerization rate and on the limiting conversion values were studied. The initial polymerization rates of microcrystalline samples obtained by rapid cooling are considerably higher than those obtained for macrocuptalline samples obtained by slow cooling. After initial polymerization, the situation is reversed, and the polymerization rates of the macrocrystalline samples are higher. (B.L.M.)

24011 RADIATION INDUCED SOLID STATE POLYMERIZATION OF ACENAPHTHYLENE. Zurakowska-Orszagh, J.; Gumulka, A. (Univ. of Warsaw). pp 633-42 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The γ-induced polymerization of acenaphthylene was studied in both the solid state and in methanol solutions. The solid-state polymerization was studied in air and in nitrogen by infrared spectroscopy. The conversion curves for crystalline and shock-cooled samples irradiated in both air and nitrogen were studied, and marked differences were noted in the two samples with a steady increase of the polymerization rate with increasing polyacenaphthylene content noted in the shock-cooled system. The effects of addition of water and of temperature on the polymerization rate was also investigated. (B.L.M.)

24012 RADIATION POLYMERIZATION OF ACENAPHTHYLENE. Muller, J. Cl. pp 643-7 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Radioinduced polymerization of acenaphthylene was studied in both the liquid and solid states. The solid-state polymerization was inhibited by air at 28°C. Conversion versus irradiation time curves were prepared. Effects of temperature and dose rate were determined. (M.C.G.)

24013 GRAFTING OF METHYL METHACRYLATE AND ACRYLONITRILE ONTO PRE-IRRADIATED POLY(VINYL CHLORIDE) FILMS. Chapiro, A. (CNRS, Bellevue, France); Mankowski, Z. pp 649-57 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The kinetics of grafting methyl methacrylate and acrylonitrile onto films of pre-irradiated poly(vinyl chloride) (PVC) either in a vacuum or in air were investigated. The PVC films were pre-irradiated with γ irradiation and the grafting was achieved by heating for various periods of time at different temperatures. The data indicate that the reaction for grafting onto vacuum-irradiated PVC films is initiated by trapped radicals. The rate of grafting was reduced at elevated temperatures; and since the reaction and growth of the grafted branches occur during the swelling of the film, the elevated temperature allows a significant diffusion of the polymer molecules so that radical-radical recombination and chain termination does indeed occur. Several conclusions concerning the preoxidation of PVC films are drawn and related to the grafting onto air-irradiated films. (B.L.M.)

24014 RADIATION GRAFTING IN THE VITREOUS STATE AT LOW TEMPERATURE. Chapiro, A.; Jendrychowska-Bonamour, A. M. (CNRS, Bellevue, France). pp 659-63 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Studies of γ-induced grafting of acrylonitrile, styrene, and isobutylene onto poly(vinylchloride) (PVC) films at –78 and –196°C when the mixtures were in the form of glasses are reported. The reactions were found to proceed by either free radical (acrylonitrile) or cationic mechanism (isobutylene and presumably styrene). Since the graft polymerization was found to proceed by an ionic mechanism, it seems certain that ionic species resulting from the irradiation of PVC films can initiate polymerization and that the monomer becomes chemically bound to the initiating polymeric ion. (B.L.M.)

24015 DIRECT RADIATION AND SPONTANEOUS GRAFTING OF STYRENE ONTO POLYOLEFINS. Dobo, J. (Research Inst. for Plastics, Budapest); Czvikovszky, T.; Ranogajec, F. pp 665-76 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Studies were made of the direct grafting of styrene onto polyethylene and polypropylene, and the spontaneous (thermal) grafting of styrene onto polyethylene, and the results are compared and correlated with the thermal homopolymerization of styrene. The rate of the direct radiation grafting of styrene onto both polyolefins was constant and dependent on the 0.5th power of the dose rate. The rate of initiation for both the direct radiation grafting and for spontaneous grafting are calculated, and the thermal polymerization inside the polyolefin films fully accounts for the spontaneous grafting. It was concluded that the diffusion of the monomer is rapid and that the grafting reaction is controlled by polymerization kinetics rather than by the chemical structure of the base polymer. (B.L.M.)

24016 GAMMA RADIATION INDUCED GRAFT COPOLYMERIZATION OF STYRENE ONTO POLY(VINYL CHLORIDE). Langner, H.; Wuckel, L. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 677-83 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effects of stabilizers in the polyvinyl chloride film (PVC), grafting time, grafting temperature, and pre-irradiation dose on the γ-induced grafting of styrene onto PVC were investigated. The grafting process was found to be of the free radical type, and the course of grafting was identical in each experiment: an initial rapid increase followed by a slower process that proceeds at a constant rate up to fairly high conversions. A possible reaction scheme is that reactive monomer radicals are formed by thermal homopolymerization, which forms secondary radicals on the PVC chain by transfer reaction. (B.L.M.)

24017 INVESTIGATIONS ON GRAFT COPOLYMERIZATION BY ELECTRON SPIN RESONANCE. II. POLY(CHLORO TRIFLUORO ETHYLENE)-STYRENE. Hedvig, P.; Dobo, J. (Research Inst. of Plastics, Budapest). pp 685-91 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The grafting of styrene onto poly(chlorotrifluoroethylene) was studied by ESR. Radical decay curves measured during the course of grafting under the influence of x radiation are characterized by two distinct portions, a fast linear decay of the peroxy radicals and a much slower portion. After storage for 10 hours, the radicals decayed below the sensitivity of the spectrometer. Both the radical combination curves and the radical decay curves measured during the course of grafting and compared with those previously measured for grafting styrene onto poly(tetrafluoroethylene) indicated that the physical structure of poly(chlorotrifluoroethylene) is much more favorable to grafting reaction. (B.L.M.)

24018 EFFECT OF MONOMER STRUCTURE ON THE EFFICIENCY OF RADIATION INDUCED GRAFT COPOLYMERIZATION. Zurakowska-Orszagh, J. (Univ. of Warsaw). pp 693-701 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The γ-induced grafting efficiency in comparison to simultaneous homopolymerization under identical experimental conditions was studied for the grafting of the following monomers onto polyethylene: acrylic acid, methacrylic acid, methyl acrylate, methyl methacrylate, butyl acrylate, butyl methacrylate, acrylamide, methacrylamide, N-phenyl acrylamide, and N-phenyl methacrylamide. Peroxide-initiated graft polymerization was used as a basis for comparison. Higher grafting efficiencies and lower homopolymerization were noted for all the methacrylic series, except methyl methacrylate, than for the acrylic series: and in all cases radioinduced grafting gave higher yields than those measured for chemical initiators. There was some indication that the solubility of the polymers influences the grafting efficiency since highest grafting yields were obtained with methacrylic acid, which gave polymers soluble in methanol and the lowest grafting yields with methyl acrylamide, which precipitates after polymerization. (B.L.M.)

24019 RADIATION GRAFTING OF VINYL PYRROLIDONE ON ACETYL CELLULOSE. Usmanov, Kh. U.; Tillaev, R. S.; Tashmuhamedov, S. A. (Tashkent State Univ.). pp 703-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Graft copolymers of acetyl cellulose and vinyl pyrrolidone were synthesized by γ irradiation of the monomer in the absence of O_2, extraction of the homopolymer from the reaction mixture with water, and extraction of the ungrafted acetyl cellulose with acetone to leave the graft polymers. The graft copolymers prepared in this manner were used to determine the solubility of copolymers in general prepared by ionizing radiation. The physicochemical properties of samples of the copolymers prepared at different radiation doses and at different monomer concentrations are tabulated. The data indicate that not only the nature of the polymer components but also the effect of γ irradiation on the components determines the properties of the radiation-synthesized graft copolymer. (B.L.M.)

24020 RADIATION GRAFTING OF ACRYLONITRILE ON CELLULOSE FROM THE VAPOR PHASE. Usmanov, Kh. U.; Asisov, U.; Sadykov, M. U. (Inst. of Chemistry, Tashkent. Tech. of Cotton Cellulose, Tashkent). pp 709-14 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Results of studies of γ-induced vapor-phase grafting of acrylonitrile onto cellulose indicated that increasing relative humidity of the atmosphere where grafting takes place favors higher grafting yields. The influence on the mechanical properties of the graft copolymer of irradiation dose, irradiation intensity, residual pressure on the system after degassing and freezing of acrylonitrile, and micro-organisms were investigated. The results indicated that vapor-phase grafting is an effective method for the modification of cellulose properties without the formation of by-products. (B.L.M.)

24021 MODIFICATION OF POLYESTER TYRE CORD AND FOIL TO INCREASE THEIR ADHESION TO RUBBER. Bulhak, Z.; Zielinski, W. (Inst. of Nuclear Research, Warsaw). pp 727-31 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Experiments were carried out to modify poly(ethylene terephthalate) tire cord and foil to increase their adhesion to rubber by radioinduced graft copolymerization of monomers onto the cord or foil. Gamma radiation was used to induce the grafting of the

following monomers: styrene, butadiene, dimethyl butadiene, and methacrylic acid. All the monomers increased the adhesion of the foil to the rubber with the best adhesive properties being obtained with dimethyl butadiene. The most efficient monomer for improving the adhesive properties of the cord was styrene giving a 95% rise in adhesion to rubber. Butadiene and dimethyl butadiene were much less efficient as adhesion improvers but they did not change the elasticity of the yarns. (B.L.M.)

24022 HYDROPHILIZATION OF POLYESTER FIBRES BY RADIATION GRAFT COPOLYMERIZATION. Zielinski, W.; Achmatowicz, T.; Robalewski, A. (Inst. of Nuclear Research, Warsaw). pp 733-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Poly(ethylene terephthalate) was graft polymerized with 4-vinylpyridine and with acrylic and methacrylic acid using γ radiation to improve the moisture and dye absorption of the fibers from dye baths. The addition of Ni^{2+} and Fe^{2+} ions increased the degree of grafting. The tensile strength of the fiber grafted by the post-effect method was greatly reduced at the expense of improved dyeability. However, valuable hydrophilic properties that improved the absorption of both moisture and dyes with very little accompanying loss of tensile strength were found to result from the simultaneous irradiation and grafting of the fiber at high temperature from aqueous solutions of acrylamide or methacrylamide containing mono- or polycarboxylic acids. (B.L.M.)

24023 ROLE OF CROSSLINKS IN THE RECOMBINATION OF RADICALS IN IRRADIATED ELASTOMERS. Kuzminskii, A. S.; Kvashenko, Ya. Ya.; Fedoseeva, T. S. (Scientific-Research Inst. of Rubber Industry, Moscow). pp 741-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effect of crosslinks on the radical recombination kinetics at the phase-state change and the effect of crosslinks on the reaction rates of free radicals over a range of temperature from −196°C to room temperatures were investigated using γ-irradiated poly(dimethyl siloxane). The ESR method was used for the experimental observations. Radical decay kinetics were found to depend on the nature of crosslinks and on the dimensional network density for the temperature range studied. Below the phase transition interval radical recombination in natural rubber hydrocarbons occurred as a result of the free valency transmission along the molecular chain. In the phase transition range, the radicals recombine by diffusion in the molecular chain parts, and the rate of the process depended on the number of crosslinks and on the radical distribution corresponding to these links. In the temperature range above the phase transition interval, the radicals decayed with a low rate that depended on the steric difficulties of their recombination. (B.L.M.)

24024 MECHANISM OF RADIATION VULCANIZATION OF LATEX. Todorov, I. M. (CEN, Saclay, France). pp 749-56 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Studies were carried out to elucidate the mechanism of irradiation crosslinking of rubber in the latex phase. Natural rubber latex was irradiated at room temperature and at −180°C with a ^{60}Co source, and the influence of the radicals and free electrons was studied by the addition of selective interceptors. The interceptors investigated were n-propanol, isopropanol, KI_3, nitromethane, nitrobenzene, $CHCl_3$, CCl_4, CH_2Cl_2, $CH_2ClCHCl_2$, and $C_6H_4(CH=CH_2)_2$. All the Cl-containing products and divinylbenzene increased the degree of intermolecular crosslinking, while the nitroproducts and KI_3 delayed it. An essential difference was noted in the degree of crosslinking when the irradiation was performed at the two vastly different temperatures. (B.L.M.)

24025 SIMULTANEOUS CROSSLINKING AND DEGRADATION OF POLYMERS IN ORGANIC SOLUTIONS BY GAMMA RAYS. Schnabel, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 757-63 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Investigations were carried out to determine the fraction of crosslinking and degree of degradation due to γ irradiation of polymers in organic solutions by studying the behavior of poly(dimethylsiloxane) in toluene. The dependence of the fraction of crosslinking and degree of degradation on polymer concentration was lower than some critical concentration. The results indicated that there is a transition from molecular crosslinking to the main-chain scission at the critical concentration. Expressions for the values of the fraction of crosslinked and degraded base units/MRAD were arrived at by combining measurements of the weight and number average molecular weight of the irradiated polymer. (B.L.M.)

24026 MECHANISM OF THE RADIATION OXIDATION OF POLY(VINYL CHLORIDE). Zeppenfeld, G.; Wuckel, L. (Institut fuer Metallphysik und Reinstmetalle, Dresden). pp 765-74 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

In an effort to explain the aging of poly(vinyl chloride) (PVC) under the influence of sunlight and air, the γ-induced oxidation of PVC in the presence of O_2 was investigated. The formation of hydroperoxide radicals, ROOH, and of peroxy radicals, ROO, were studied as a function of radiation dose and irradiation temperature. The hydroperoxide yield, dehydrochlorination, and chain scission were all found to be independent of dose rate and to require no thermal activation. It was assumed that chain fracture results from direct scission of C-C bonds under the influence of O_2. G values are given for HCl formation and for chain fracture. (B.L.M.)

24027 MECHANISM OF LOW-TEMPERATURE RADIOLYSIS OF POLY(VINYL CHLORIDE). Kotov, B. V.; Pravednikov, A. N. (Karpov Inst. of Physical Chemistry, Moscow). pp 775-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Some data indicating ionic reactions in low-temperature radiolysis of poly(vinyl chloride) involving capture and stabilization of electrons are presented. The samples were irradiated at 77°K in a vacuum by both γ and uv radiation. The irradiations were carried out both in the presence and absence of electron acceptors. Conclusions were drawn as to what part in the radiation-chemical behavior is played by the active centers and the solvated electrons, and some effort is made to explain the different experimental results obtained with the two different radiations. (B.L.M.)

24028 INFLUENCE OF IONIZING RADIATION ON THE MOLECULAR WEIGHT DISTRIBUTION OF POLY(ETHYLENE TEREPHTHALATE). Turska, E.; Boryniec, S. (Politechnika Lodzka, Lodz, Poland). pp 781-4 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Samples of poly(ethylene terephthalate) were irradiated in air-filled ampuls with pile radiation and the dose rate was accurately known for thermal neutrons, fast neutrons, and gamma radiation. The results suggest that under the experimental conditions two processes occur simultaneously: (1) a degradation process and (2) formation of branched structures, which in the next step undergo crosslinking with the degree of crosslinking dependent on the total radiation dose. (B.L.M.)

24029 THERMOLUMINESCENCE OF SOME IRRADIATED POLYMERS. Mozisek, M. (Research Inst. of Rubber and Plastics Tech., Gottwaldow, Czechoslovakia). pp 785-90 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Samples of polyethylene, polypropylene, ethylene-propylene rubber, butyl rubber, butadiene-styrene rubber, and poly(tetrafluoroethylene) were irradiated at −196°C and then heated to 100°C at a constant rate to measure the thermoluminescence of the polymers. Intensity of thermoluminescence vs temperature curves were plotted for each polymer, and some future experiments are outlined. (B.L.M.)

24030 PHOTOLUMINESCENCE OF IRRADIATED PLEXIGLASS. Szentirmay, Zs.; Dezsi, Z.; Patko, J. (Kossuth Univ., Debrecen, Hungary. Univ. of Medicine, Debrecen, Hungary). pp 791-8 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The effects of both γ and uv radiation on plexiglass were investigated. Two independent radiolytic decomposition processes are proposed that take place simultaneously in irradiated plexiglass containing 5% dibutyl phthalate as a plasticizer to produce one or more fluorescent products. (B.L.M.)

24031 RADIATION INDUCED POLYMERIZATION OF ALIPHATIC AND ALICYCLIC OXIDES. Cordischi, D.; Mele, A.; Somogyi, A. (CNEN, Rome. Univ., Rome). pp 483-91 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radioinduced polymerization of aliphatic and alicyclic oxides was studied in both liquid and solid state for a number of monomers. Some monomers do not give polymers, even with high radiation doses, others polymerize giving low molecular weight polymers, and some alicyclic epoxides and tetrafluoroethylene oxide give high polymers. Tetrafluoroethylene oxide polymerizes only if irradiated in the solid state, but aliphatic epoxides have no tendency to polymerize. The reaction mechanism of the polymer-

ization of 1,2-cyclohexene oxide was studied in detail. The addition of H_2O and NH_3 drastically reduced the rate of polymerization. From the kinetic data, expressions were derived for the reciprocal of the polymerization rate and of the degree of polymerization. The evidence gathered from the studies of the monomers strongly favors a cationic mechanism of polymerization. (B.L.M.)

24032 SOLID STATE POLYMERIZATION IN TWO-COMPONENT SYSTEMS. Hardy, Gy.; Varga, J.; Nagy, G.; Nyitrai, K.; Varga, E. (Technical Univ., Budapest. Research Inst. for Plastics, Budapest). pp 539-46 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Gamma-induced solid-state polymerization of the following systems was investigated: benzoquinone (BQ)–acrylamide (AA); BQ–trioxane (TO); BQ–vinyl laurate (VL); succinimide (SI)–TO; naphthalene (N)–TO. Previous reported work on these systems or on the solid-state polymerization of the monomer is reviewed and phase diagrams for the systems are presented. The polymerization kinetics of the systems were investigated in a wide range of compositions. Certain inhibitor studies were carried out, and it was concluded from the data that the mechanism of solid-state polymerization can only be determined for systems in which the destruction of the crystal lattice is favorable to polymerization. Strong retarding effects of inhibitors were noted in the polymerization of vinyl monomers with long aliphatic chains, and this indicated that the polymerization probably has a radical mechanism. (B.L.M.)

24033 WOOD-PLASTIC COMBINATIONS PREPARED BY IRRADIATION WITH GAMMA RAYS AND HIGH ENERGY ELECTRONS. Singer, K. A. J. (Danish Atomic Energy Commission, Risoe, Denmark). pp 715-26 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The electron- or γ-induced graft polymerization of three monomer systems, methyl methacrylate, vinyl acetate, and a styrene-acrylonitrile mixture in three different species of Scandinavian woods (spruce, pine, and beech) was investigated. The effects of dose rate, type of wood, irradiation temperature, and additives, such as CCl_4 and water, are all reported. Graft polymers were not formed during γ-irradiation of methyl methacrylate in dried wood, but when the wood was swollen with water before impregnation, a large proportion of graft copolymer was formed. The amount of "fixed" polymer was twice as high in spruce as in pine and beech for methyl methacrylate, and the molecular weight of the extractable polymer was much higher for spruce than for the other two woods. (B.L.M.)

24034 RADIATSIONNAYA FIZIKA. IV. IONNYE KRISTALLY. (Radiation Physics. IV. Ionic Crystals). Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. 133p.

The effects of irradiation on ionic crystals are discussed in 16 papers by noting changes in physical properties, luminescence mechanism, heterogeneous catalysis, and physical chemical features of solid radioactive samples. Separate abstracts were prepared for 13 of the papers. (M.C.G.)

For abstracts of individual papers see: 24035–24039, 24056, and 25207–25213.

24035 CHEMICAL ACTIVATION OF SOLID SURFACES BY RADIATION. Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Academy of Sciences, USSR). pp 5–11 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

The effect of radiation on matter is reviewed. These radiation effects depend on the following factors: continuous excitation of electrons in the irradiated atoms; the appearance of local charge on the sample surface due to the emission of charged particles and liberated electrons; defect formation in the crystal lattice due to recoil; or to the interaction of radiation with the atoms. The rate of isotopic sulfur exchange at a temperature of 1113°K in the heterogeneous $K_2S^*O_4$–SO_3 system passes through a maximum and a minimum on increasing the specific activity from 2 to 35 mCi/g. Apparently an unstable pyrosulfate is formed by the reaction: $K_2SO_4 + SO_3 \rightleftharpoons K_2S_2O_7$. External irradiation of K_2SO_4 in SO_3 vapor with high-energy electrons has no effect on the rate of isotopic exchange. The evaporation rate of MoO_3 showed a minimum, which disappeared when a grounded Pt wire was introduced into the crucible. The dehydration of cyclohexanol over MgS^*O_4 showed analogous effects. (TTT)

24036 THE MUTUAL RELATIONSHIP BETWEEN RADIOCHEMICAL AND RADIATION EFFECTS IN KCl CRYSTALS IRRADIATED BY HIGH-ENERGY PROTONS. Bogdanov, R. V.; Murin, A. N. (Leningrad State Univ.). pp 13–21 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

The influence of radiation and photochemical effects on the chemical state of atoms of radioactive phosphorus in potassium chloride were determined. The KCl crystals (pure and with $CaCl_2$ admixture) used as targets for proton irradiation were grown by the Kiropoulos method. The crystals were placed in light tight boxes and exposed to an external beam of protons at 660 MeV with a maximum total proton flux of $2 \times 10^{12}/cm^2$. The crystals were also exposed to light in the F band (560 nm) for different durations, after which the distribution of the activity of the radioactive phosphorus was determined for the three produced fractions (phosphate, phosphite, and hypophosphite). Illumination of the crystal decreased the yield of the phosphate and phosphite radioactive phosphorus, and increased the yield of the hypophosphite fraction. After about three hours of illumination, the concentrations of the activity of the phosphorus by fractions changed from 35.5, 20, and 44.5% for H_3PO_4, H_3PO_3, and H_3PO_2, to 20, 10, and 70%, respectively. In the mixed crystals the redistribution of the activity occurred at a lower speed, and no plateau was reached even after ten hours. Total bleaching of the crystals showed that after 8 or 10 days the processes reverse, and the activity of the hypophosphite decreases whereas that of the phosphite and phosphate increases. The effect of proton irradiation on the chemical state of the radioactive phosphorus was also studied and it was found that proton irradiation first oxidizes the radioactive phosphorus intensely, after which the rate of oxidation decreases and reduction of the radioactive phosphate sets in. Possible causes of all the effects are indicated. (ATD)

24037 ELECTRON PARAMAGNETIC RESONANCE METHOD FOR DETECTION OF CAPTURED ELECTRON IN IRRADIATED FROZEN ALKALI LIQUORS. Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Academy of Sciences, USSR). pp 39–47 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

An alkaline medium favors the existence of the hydrated electron e^-_{aq}, which reacts readily with hydrogen ions in a neutral or acid medium by the reaction $e^-_{aq} + H^+ \rightarrow H$. A solution 10 M in KOH irradiated at 77°K gave an electron paramagnetic spectrum of two lines: a wide line with a g-factor of 2.04 and a width of about 40 oe, and a narrow line with a g-factor coinciding with the g-factor of a free electron and a width of about 13 oe. The color of the irradiated alkaline ice was dark blue, while irradiated neutral ice showed no color. The wide line in the EPR spectrum of the alkaline solution was assigned to the hydrated ion–radical O^-_{aq}, which is the dissociated form of the OH radical: $OH \rightleftharpoons O^- + H^+$. The evidence for the existence of the O^-_{aq} radical is reviewed. The narrow line in the EPR spectrum is assumed to belong to the captured electron on the basis of the intensive coloration of the solution and its similarity to the g-factor of the free electron. (TTT)

24038 RADIATION DAMAGE IN RADIOACTIVE AND GAMMA-IRRADIATED SPECIMENS OF $CaSO_4$, $SrSO_4$, AND $BaSO_4$. Gromov, V. V.; Karaseva, L. G. (Inst. of Physical Chemistry, Academy of Sciences, USSR). pp 49–55 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

The accumulation of paramagnetic centers in SrS^*O_4 and BaS^*O_4 (the star indicates a labeled atom) with initial ^{35}S activities of 5 and 20 mCi/g was followed by electron paramagnetic resonance (EPR). The EPR signal in $SrSO_4$ (20 mCi/g) appeared a few hours after preparation, and an equilibrium concentration of paramagnetic centers (5×10^{18}/g) was attained in five days. The $BaSO_4$ was more resistant to radiation and gave an equilibrium concentration of paramagnetic centers lower by a factor of five than that obtained with SrS^*O_4. The CaS^*O_4 salt containing two molecules of water of crystallization gave no EPR signal. On varying the specific activity from 0.1 to 50 mCi/g in SrS^*O_4 and holding for a 55-day irradiation, a perceptible concentration of paramagnetic centers was observed at a lower specific activity of 0.8 mCi/g. A saturation effect was observed at the higher specific activities. Nonradioactive salts of $CaSO_4$, $SrSO_4$, and $BaSO_4$ were irradiated with ^{60}Co gamma rays (absorbed dose $\sim 10^{20}$ eV/g). A decrease in the number of paramagnetic centers was observed to take place in jumps with increasing temperature to 900°C. (TTT)

24039 RADIATION CHEMICAL PROCESSES IN IONIC CRYSTALS. I. GAMMA RADIOLYSIS OF ALKALI HALIDE CRYSTALS. Shvarts, K. K.; Tiliks, Yu. E.; Tone, D. K.; Ulmane, I. M. (Inst. of Physics, Academy of Sciences, Latvian SSR). pp 57–69 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

The process of γ radiolysis was investigated in the homologous series of the alkali halides, KCl, KBr, KI, and NaCl. It was found that, along with the stable products, three halogens and electron and colloidal centers appear. The yields of the radiolytic products are in the order of magnitude of 10^{-2} mol per absorbed 100 eV energy. The radiolysis process depends to a great degree on

the presence of impurity defects. An increase of the admixtures by two causes an increase in yield of the radiolytic products by an average of 20%. The products of irradiated crystals change little with time. Only the diffusion of gaseous products from the crystals into the gaseous phase was observed. Optical and thermal bleaching causes an increase in the yield of metallic products. The quantity of halogen formed is not altered; only the diffusion process is accelerated. (tr-auth)

24040 GAMMA RADIOLYSIS OF LIQUID CYCLOPENTANONE. Bristowe, William Warren. Newark, Del., Univ. of Delaware, 1965. 121p.

Thesis.

The γ-radiolysis of liquid cyclopentanone was studied. Primary products and their initial G values are: hydrogen 0.68 ± 0.02, carbon monoxide 0.8 ± 0.1, ethylene 0.85 ± 0.04, cyclobutane 0.11 ± 0.01, 1-butene 0.07 ± 0.01, n-butane 0.05 ± 0.01, 4-pentenal 0.74 ± 0.05, cyclopentanol 0.81 ± 0.05, 2-cyclopentenone 0.21 ± 0.02, dimer 0.23 ± 0.02, and polymer 4.4 ± 0.5 (reported in terms of cyclopentanone units). The polymer was fractionated into three components. Two of these constituted about 98% of the total polymer and were characterized by spectroscopic and elemental analysis. The effects of added iodine, DPPH, cyclohexene, and oxygen were studied on the pure liquid. Based on these results mechanisms for product formation were postulated. Cyclohexene-cyclopentanone mixtures were studied to verify the minimum in the H_2 yield curve previously observed in this system and to find the effects produced on the other products. The general kinetic cases for various kinetic reaction mechanisms involving interactions of two components were reevaluated. One of these cases was further complicated by addition of terms to make it comparable to the experimentally observed case. Application of the theoretical case agrees with the experimental case to within 10%. It is therefore postulated that the interaction between these two components is radical scavenging by cyclohexene and energy transfer by cyclopentanone. Some comparisons between the radiolysis, photolysis, and pyrolysis of cyclopentanone are presented. (Dissertation Abstr.)

24041 IMPROVEMENTS RELATING TO THE MANUFACTURE OF PLASTICS. Charlesby, Arthur; Pinner, Solomon Harris (to T. I. (Group Services) Ltd.). British Patent 866,069. Apr. 26, 1961. Filed Feb. 14, 1956.

A process for improving the properties of a polymer comprises mixing the polymer with a poly-functional monomer containing at least two potentially reactive C to C double bonds with one pair of C atoms joined by double bonds separated from the next pair of such C atoms by at least one C atom and crosslinking the polymer with the monomer by subjecting the mixture to the effects of electrons, gamma radiation, or x rays. The process may be carried out in the presence of a second monomer, which has the function of enhancing the compatibility of the polymer and the first monomer and which may or may not be polyfunctional. The process is applicable to the cross-linking of polymers of ethylene, methylmethacrylate, vinyl chloride, acrylonitrile, or cellulose acetate. The polyfunctional monomer may be divinyl benzene, ethylene dimethacrylate, or diallyl phthalate. The second monomer is chosen from vinylidene chloride or lauryl methacrylate. (B.L.M.)

24042 STUDY OF FREE RADICALS FORMED BY IRRADIATION DURING THE GRAFTING OF VINYL MONOMERS ON CELLULOSE. Gagnaire, D.; Bernard, O.; Vincendon, M. (CEN, Grenoble, France. Ecole Francaise de Papeterie, Grenoble, France). 9p. (In French). (CONF-640716-1). DTIE.

From International Symposium in Chemistry, Biochemistry of Lignin, Cellulose and Hemicelluloses, Grenoble, France.

A study on the grafting of styrene on cellulose by γ radiation showed that the radicals can be divided into two different classes according to their reactivity with water. The more active radicals did not participate in the grafting. Comparison of the effects of reactor irradiation and electron beam irradiation showed that there are differences in the accessibility of radicals of the same nature according to the irradiation procedure producing them. The principal difference between cellulose and its derivatives is the behavior difference of oxygen. The results obtained are tabulated according to the mode of irradiation and show the effect of the experimental factors: preirradiation or simultaneous irradiation, degassing of the solution, and effect of the nature of the cellulose or monomer support. (J.S.R.)

24043 GAS PHASE RADIOLYSIS OF CH_3I–n-C_5H_{12}–I_2 MIXTURES. Kang, Hong Yol. Madison, Wis., Univ. of Wisconsin, 1966. 146p.

Thesis.

Further information about the mechanism of the radiolysis of alkyl halide–n-pentane–I_2 systems was obtained by extending previous studies on similar systems in the liquid phase to the gas phase. This was done by observing radical products, which were scavenged by I_2(^{131}I) and detected as $R^{131}I$, under various conditions of CH_3I and I_2 concentrations, total sample pressure, irradiation temperature, and applied electric field. The samples were irradiated with a ^{60}Co γ source at a dose rate from 2.1×10^{18} to 1.5×10^{18} ev g^{-1} min^{-1} during the course of this work. Identification of radical products and determination of their yields were carried out using gas chromatography with a radioactivity detector. The iodine scavenger was present at a mole fraction of 10^{-3}, and the radical product distributions were observed over the range of conversions at which 5 to 10% of the ^{131}I was found in organic combination. In n-C_5H_{12} at 100 torr pressure containing 0.5 mole % CH_3I and different concentrations of I_2, the yields of all the $R^{131}I$ species decreased with decreasing I_2 concentration at concentrations lower than 0.033 mole %, suggesting that removal of radicals at the walls in competition with radical scavenging by I_2 may play a significant role at low I_2 concentrations. The observed pressure effect on the radical product distribution appeared to support a mechanism in which unimolecular dissociation and fluorescence emission of excited C_5H_{12} are important at low pressures, and energy transfer processes are important at high pressures, whereas dissociative electron attachment and iodine abstraction from CH_3I by H atoms remain important independent of pressure. Interpretation of the experimental evidence also suggests that ions are removed by the walls at low concentrations. The yields of radical products changed with increasing temperature or with applied electric field. All the experimental observations were consistent with the conclusion that in gas-phase radiation chemistry of CH_3I–n-C_5H_{12}–I_2 mixtures important elementary processes are hydride ion transfer from C_5H_{12} to fragment ions, dissociative electron attachment to CH_3I, iodine abstraction from CH_3I by H atom, charge neutralization between $C_5H_{11}^+$ and I^-, and energy transfer. Also under certain conditions wall effects on radicals and ions seem to play significant roles. (Diss. Abstr.)

24044 SOME STUDIES ON THE RADIOLYSIS OF BENZENE. Hite, Joe Roger. Princeton, N. J., Princeton Univ., 1966. 129p.

Thesis.

Samples of carefully purified benzene were irradiated with ^{60}Co γ rays and with the products of the $^{10}B(n,\alpha)^7Li$ reaction. In the latter experiments the benzene was mixed with decaborane and irradiated in a high thermal neutron flux in a nuclear reactor. Comparison of the yields of hydrogen, acetylene, 1,4-cyclohexadiene, 1,3-cyclohexadiene, and biphenyl from these two types of radiation provided information on the effects of LET (the rate at which a charged particle loses energy as it traverses a medium) on the formation of these products. Strong increasing effects were found for hydrogen and acetylene with smaller effects for the cyclohexadienes. A slightly decreasing LET effect was found for biphenyl. The G values from ^{60}Co γ ray irradiation were: $G(H_2)$ = 0.042, $G(C_2H_2)$ = 0.021, G(1,4-cyclohexadiene) = 0.0213, G(1,3-cyclohexadiene) = 0.0092, and G(biphenyl) = 0.139. The G values from irradiation with the products of the $^{10}B(n,\alpha)^7Li$ reaction were: $G(H_2)$ = 0.56, $G(C_2H_2)$ = 0.25, G(1,4-cyclohexadiene) = 0.077, G(1,3-cyclohexadiene) = 0.066, and G(biphenyl) = 0.095. An unexpected reaction between acetylene and decaborane was indicated by a non-linearity in the yield of acetylene. The extent and nature of this reaction and its effect on the benzene radiolysis mechanisms were investigated. In addition, a proposed irradiation of benzene with fast neutrons from the $^3H(d,n)^4He$ reaction is discussed and an improved experimental apparatus for fast neutron irradiation of liquids is described. Included is a device designed to allow using the liquid being irradiated as the cooling medium for a deuteron accelerator target. (Diss. Abstr.)

24045 AN ELECTRON SPIN RESONANCE STUDY OF X-RAY IRRADIATED BINARY MIXTURES OF CONJUGATED RING SYSTEMS AND ALCOHOLS. Leone, James Anthony. Baltimore, Md., Johns Hopkins Univ., 1965.

Thesis.

Binary mixtures of conjugated ring systems and alcohols were irradiated with high energy x rays at 77°K. The free radical intermediates were then studied using electron spin resonance (ESR) spectroscopy. The systems studied were benzene and naphthalene in methanol and ethanol; toluene, o-, m-, and p-xylene, mesitylene, nitrobenzene, pyridine, and pyrrole in methanol. Through ESR spectroscopy of these mixtures and their various deuterated analogs at varying cryogenic temperatures along with correlating data from mass spectral analysis some of the initial radiolytic products were determined. Secondary free radicals were analyzed and a mechanism is postulated for the results obtained. Indications are that the initial release of a hydroxyl hydrogen atom from the alcohol is the primary reacting species. This hydrogen atom then forms abstraction and addition products with the alcohols and ring systems. Molecular orbital calculations of unpaired spin densities by the McLachlan process were carried out on the conjugated ring-hydrogen atom addition products. The results support

assignments given to some of the ESR spectra and in some cases give a very good match to the experimental spectra obtained. (Diss. Abstr.)

24046 THE SZILARD–CHALMERS REACTION IN A SERIES OF PRASEODYMIUM β–DIKETONE CHELATES. Ilardi, Joseph Michael. New York, Fordham Univ., 1966. 109p.

Thesis.

Solvent extraction and radiochemical methods were employed to determine the effects of thermal neutron and ^{60}Co gamma radiation on a series of chelates with praseodymium. The ligands used in the study were chosen so as to produce a series of chelates whose molecular weights, stability constants, and terminal group conjugation showed a gradual increase. The ligands used were: acetylacetone (2,4-pentanedione), 1-phenyl-1,3-butanedione, 1,3-diphenyl-1,3-propanedione, and 2-thenoyl-trifluoroacetone. A comparison of the extraction data for the pre- and post-thermal neutron irradiated chelates revealed that the physical properties of the ligands dictated the amount of radiolysis that the chelates underwent. These same properties also had an effect on ^{142}Pr distribution between an aqueous and chloroform phase after occurrence of the ^{141}Pr (nγ) ^{142}Pr reaction. Using a combination of radiochemical and solvent extraction data it was possible to show that the chelates that possessed higher molecular weights, stability constants, and terminal group conjugation exhibited a greater resistivity towards radiolysis. The chelates irradiated in the reactor showed a combined radiolysis due to the high gamma fluxes present in the graphite reactor employed. A series of ^{60}Co gamma irradiations were performed on the chelates; a comparison of the extraction results for the reactor and ^{60}Co gamma irradiated samples enabled the damage caused by the thermal neutrons and by the gamma rays to be differentiated. The radiolysis caused by the neutrons was recombining with a measurable half-life whereas the gamma damage was permanent. Several of the chelates studied were used to effect an isotope enrichment of the ^{142}Pr produced in the reactor. Using a modified extraction procedure a 17% enrichment factor was achieved for the Pr tris-2-thenoyltrifluoroacetonate. Predictions could also be made as to what chelate structures would afford even higher enrichment factors. The 2-thenoyltrifluoroacetonate compounds showed great promise as gamma dosimeters. From a series of preliminary investigations the effective range for these compounds would be $> 15 \times 10^6$ rad. They would be very useful in the high total dose range due to their great stabilities towards radiolysis. There was also the possibility that they could be used as "dual dosimeters" to map the thermal neutron as well as the gamma fluxes present in a graphite moderated reactor. (Dissertation Abstr.)

24047 RADIATION-INDUCED REACTIONS IN ALKYL BROMIDES. Martin, Donald Houston. Knoxville, Tenn., Univ. of Tennessee, 1966. 170p.

Thesis.

Reactions induced in some alkyl bromides by irradiation with ^{60}Co γ radiation were studied. The yields of the organic salt, tropylium bromide ($C_7H_7Br^-$) produced in the radiolysis at ambient temperature of binary solutions of alkyl bromides with 1, 3,5-cycloheptatriene (CHT) were determined gravimetrically. Isobutane analyzed by gas chromatography was the major product of the radiolysis of pure t-butyl bromide with G(isobutane = 5.37 at 0.458×10^{21} eV/g and 5.38 at 0.948×10^{21} eV/g. The G(isobutane) in the radiolysis of t-butyl bromide with CHT mole fraction of 0.0850 was 4.41 at 0.953×10^{21} eV/g and 2.82 at 1.98×10^{21} eV/g. The results were shown to be consistent with a mechanism in which the tropylium cation results from the abstraction of a hydride ion, H^-, from CHT by an alkyl carbonium ion. Also consistent with the results is tropylium cation production by dissociative charge transfer from the alkyl bromide molecule-ion to CHT. Irradiated n-butyl bromide analyzed by gas chromatography indicated sec-butyl bromide yields such that a chain reaction was operative. Experiments with additives indicated that the reaction was a free radical process. The concentration of sec-butyl bromide as a function of dose at two different dose rates, 3.27×10^{17} and 4.92×10^{15} eV/g min, was found to be linear at low dose giving differential G(sec-butyl bromide) at 30°C of 106.6 and 656 respectively. The differential G(sec-butyl bromide at a dose rate of 3.27×10^{17} eV/g min decreased with increasing dose beyond the range of linear concentration-dose dependency. The integral G values of sec-butyl bromide for samples given comparable doses at different dose rates were inversely proportional to the square root of the dose rate ratio at low total doses. The integral G(sec-butyl bromide) was temperature dependent with Arrhenius-type activation energies of 6.5 kcal/mole at a dose of 6.89×10^{19} eV/g and dose rate of 3.85×10^{17} eV/g min and 7.2 kcal/mole at a dose of 1.32×10^{17} eV/g and dose rate of 4.53×10^{15} eV/g min. The G of n-butane produced in the radiolysis of n-butyl bromide was independent of dose and dose rate with mean G = 3.16. The essential reactions proposed for the radioinduced isomerization mechanism were: $Br\cdot + CH_3CH_2CH_2CH_2Br \underset{k_{-3}}{\overset{k_3}{\rightleftharpoons}} HBr + CH_3CH_2\dot{C}HCH_2Br$, $CH_3CH_2\dot{C}HCH_2Br \underset{k_{-4}}{\overset{k_4}{\rightleftharpoons}} CH_3CH_2CHBrC\dot{H}_2$, and $CH_3CH_2CHBrC\dot{H}_2 + HBr \xrightarrow{k_5} CH_3CH_2CHBrCH_3 + Br$. A kinetic analysis of the total mechanism gave an equation with only two unknowns, k_{-3} and k_5, by using estimates of k_3 and k_4, the rate constant for combination of radicals, based on known rate constants for analogous processes. For the condition that $k_5 >> k_{-3}$, k_{-3} was 2.6×10^6 M^{-1} sec^{-1}, a value in good agreement with the rate constant predicted for abstraction of H· from HBr by the sec-butyl radical. The production of a "bridged" radical intermediate was shown to be inconsistent with the experimental results unless the "bridged" radical passes through a distinct radical, $CH_3CH_2CHCH_2Br$, precursor. The radiolysis of pure n-propyl bromide at 25°C gave G(isopropyl bromide) = 2.37 at a dose of 6.87×10^{19} eV/g and dose rate of 3.42×10^{17} eV/g min. cis- and trans-1-Bromo-1-propene were produced in the radiolysis of allyl bromide. cis-1-Bromo-1-propene was also found in the radiolysis of solutions of n-propyl bromide with allyl bromide. (TSS)

Radiochemistry

Refer also to abstract 23925.

24048 (TID–23803) SOME OBSERVATIONS ON THE CHEMICAL BEHAVIOR OF CARRIER-FREE ^{131}I AND DILUTE CARRIER ^{127}I. Reynolds, Manning S. (New Mexico Univ., Albuquerque). 1966. Contract AT(11-1)-733. 185p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

While studying the formation of carrier-free iodate-131 by perchloric acid oxidation of iodide-131 at elevated temperatures, it was found that the acid is not directly responsible for the formation of iodate. Instead, the oxidation is accomplished by a volatile material (thought to be chlorine dioxide) formed only in perchloric acid more concentrated than the hydrate, $HClO_4 \cdot 3H_2O$. This observation led to the development of a method for generating small amounts of chlorine dioxide for direct use as an oxidant. The gas was applied in a nitrogen gas stream to small volumes of carrier-free iodide-131 solutions during evaporation to dryness at 95°. The residue, redissolved in distilled water, provides a carrier-free iodate-131 solution free of other forms of iodine and macro amounts of other materials. Studies of the stability of such carrier-free iodate-131 showed that increasing perchloric acid concentrations resulted in increased rate and degree of decomposition; the relative yield of decomposition products (for the most part, "unidentified" species) may also be a function of the acidity. However, with 0.1 M chloride ion in solution, most of the non-iodate activity appeared to be iodide. Reduction of the iodate-131 by dilute sulfite solutions also yielded iodide-131. Reduction by a 0.005 M ferric/0.05 M ferrous redox couple in 1.0 M perchloric acid led to results predictable from the known chemistry of iodine, provided that the total (carrier) iodate concentration was 10^{-5} M or greater. In more dilute solutions, at least two "unidentified" species appeared in increased percentages as the carrier iodate concentration was decreased. Experiments to determine the coprecipitation behavior of carrier-free iodate-131 with silver halides demonstrated only surface adsorption, and only in the presence of excess silver ion. A complete range of carrying behavior was found with the homologous calcium, barium, and lead carbonates. Ferric hydroxide carried 98% of the activity in the pH range 4.5 to 6.5, whether the precipitate was performed or formed in the presence of the iodate-131. Silver bromate, and silver and lead periodates, carried the iodate-131 very strongly whether precipitated in the presence of excess anion or cation. Carrier-free iodate-131 was found to have little tendency to form radiocolloids. The chromatographic determination of ^{131}I was studied in distillate solutions of bicarbonate, cysteine hydrochloride, or sulfite. However, this method was found to be unreliable. Large and variable percentages of iodine were lost from the papers during the chromatographic process, and results were frequently at wide variance with data obtained by an established, chemically milder, solvent extraction-isotopic exchange procedure. (P.C.H.)

24049 CHEMICAL STATES OF RADIOPHOSPHORUS FORMED IN ELEMENTARY SULFUR BY THE NUCLEAR REACTION $^{32}S(n,p)^{32}P$. Bebesel, P. I.; Turcanu, C. N. (Inst. for Atomic Physics, Bucharest). J. Inorg. Nucl. Chem., 29: 891–4 (Apr. 1967).

The chemical states of the radiophosphorus were investigated by their reaction with phosphorus pentachloride, followed by hydrolysis of the reaction products, and their identification by paper radiochromatography. It was concluded that oxygen present in the crystalline lattice stabilizes the radiophosphorus in an oxidized form, and in the absence of oxygen in an elementary form. (auth)

24050 β-DECAY OF RADIOACTIVE LEAD TETRAMETHYL. Duncan, J. F.; Thomas, F. G. (Victoria Univ., Wellington, New Zealand. Townsville Univ. Coll., Australia). J. Inorg. Nucl. Chem., 29: 869-90(Apr. 1967).

A study of the decay of gaseous $^{210}Pb(CH_3)_4$ under conditions where the product was not under the influence of neighboring molecules showed that 100% of the daughter ^{210}Bi is deposited on the walls of the containing vessel. This may be interpreted in accordance with the predictions that the daughter species $Bi(CH_3)_4^+$ disproportionates to give a charged bismuth-containing fragment, rather than $Bi(CH_3)_3$. (auth)

24051 CHEMICAL EFFECTS OF THE $^{35}Cl(n,p)^{35}S$ NUCLEAR TRANSFORMATION IN SILVER CHLORIDE. Kronrad, Leo; Kacena, Vladimir (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Radiochim. Acta, 6: 181-4(Dec. 1966).

The changes in valency states of ^{35}S atoms caused by thermal and light annealing were studied in silver chloride crystals prepared in various ways (by precipitation, melting, single-crystal growth) and in plastically deformed single crystals. The fraction of ^{35}S activity associated with the sulfide fraction as a function of annealing time showed the same general pattern (e.g. several maxima and minima can be observed). The individual plots differ only in their quantitative characteristics (such as the number of maxima, their distance, etc.). The results indicate that excitons play a major role in the light annealing mechanism. (auth)

24052 A FURTHER STUDY OF WALL-EFFECTS IN GAS-PHASE RECOIL TRITIUM CHEMISTRY. Malcolme-Lawes, D. J.; Urch, D. S.; Welch, M. J. (London Univ.). Radiochim. Acta, 6: 184-7(Dec. 1966).

A correction factor for the HT produced by the reaction of recoil tritium atoms or ions with the vessel walls was determined for quartz and Corning 1720 glass. It was found that the chance of a tritium atom reentering the gas phase (as HT) decreases as the recoil loss to the wall increases. It is also shown that Spectrosil quartz reduced wall-HT and that in pyrex, A 45, and 1720 glasses it can be neglected, even at high moderation. (auth)

24053 EFFECTS OF NEUTRON CAPTURE IN DEUTERO-BROMOETHANE. Miller, G. E.; Patterson, B. C.; Shaw, P. F. D. (Nuclear Physics Lab., Oxford). Radiochim. Acta, 6: 178-81(Dec. 1966).

The total organic yields in bromoethane–bromine mixtures are greater for C_2D_5Br than for C_2H_5Br; the most marked variation between fractions was found for bromoethane whose yield (for both ^{80m}Br and ^{82}Br) was enhanced in C_2D_5Br, and 1:1 dibromoethane, whose yield was reduced. The results for both bromine isotopes can be explained by the different reactivities of H and D atoms in the thermal spikes produced, and by their mass differences. (auth)

24054 ISOTOPE EFFECTS ASSOCIATED WITH NEUTRON CAPTURE IN BROMOETHANE. Mia, M. D.; Shaw, P. F. D. (Nuclear Physics Lab., Oxford). Radiochim. Acta, 6: 172-8 (Dec. 1966).

Products containing ^{80m}Br and ^{82}Br, formed by neutron capture in bromoethane–bromine mixtures were analyzed by gas chromatography. While the total organic yields were similar, the yields of individual fractions differed markedly; the isotope ratio (^{80m}Br yield/^{82}Br yield) was less than unity for monocarbon products and varied between 0.65 and 3.27 for compounds containing two carbon atoms, being greatest for the more heavily brominated products. The results were consistent with activation of ^{80m}Br atoms by recoil, and activation of ^{82}Br atoms by Auger processes in which protons are cast off by charged molecules. Diffusive reactions of ^{82}Br are consistent with Willard's auto-radiolysis theory. (auth)

24055 OXIDATIVE RECOIL REACTIONS IN CRYSTALLINE COMPOUNDS OF UNIVALENT THALLIUM. Butterworth, J. S.; Harbottle, G. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Radiochim. Acta, 6: 169-72(Dec. 1966). (BNL-10172).

The production of oxidized recoil atom species of thallium following neutron capture in crystals of various thallous compounds was investigated. The probability of finding an oxidized recoil atom is greater the larger the oxygen to thallium ratio. The oxidized recoil fraction can be reduced by thermal annealing after neutron exposure but was insensitive to the gamma radiation dose received before, during, or after neutron activation. (auth)

24056 USE OF INFRARED SPECTROSCOPY IN THE INVESTIGATION OF DEFECTS IN RADIOACTIVE INORGANIC COMPOUNDS. Akhmanova, M. V.; Mikhailenko, I. E. (Inst. of Physical Chemistry, Academy of Sciences, USSR. Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). pp 107–10 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

Salts containing complex oxygen anions have a set of absorption bands in the infrared, which are sensitive to changes in the anions or their surroundings. It was calculated that radioactive samples of K_2SO_4 had received doses of 6.0×10^{19}, 9.1×10^{20}, 1.3×10^{21} and 2.2×10^{22} eV/g. Infrared spectra of all the samples were taken at absorption frequencies of 450, 625, 1000, 1130, and 1200 cm^{-1}. The sharp maximum in the valence band at 1200 cm^{-1} was observed to increase in intensity with initial, increasing specific activity of the radioactive salt. The decrease in symmetry of the SO_4 group was not removed on annealing the sample, but the intensity of the maxima decreased. (TTT)

24057 CHEMICAL EFFECTS FOLLOWING THE (n,2n) REACTION IN COBALTAMMINE BROMIDES. Saito, Nobufusa; Takeda, Masuo; Tominaga, Takeshi (Tokyo Univ.). Bull. Chem. Soc. Jap., 40: 690-1(Mar. 1967).

In order to compare the behavior of hot radiobromine atoms produced in different nuclear reactions, the behavior of ^{76}Br, arising from (n,2n) reaction induced by fast-neutron irradiation of the complex salts $[Co(NH_3)_5X]\ Br_{2,3}$ and $[Co(en)_2X_2]\ Br_{1,3}$ was investigated. After the complexes were irradiated with 14-MeV neutrons, the samples were dissolved in water and the solution passed through columns of cation exchange resin and anion exchange resin, successively. The fraction adsorbed on the cation exchanger contained ligand bromine including radiobromine, whereas the fraction absorbed on the anion exchanger contained bromide ions and anionic radiobromine. Measurements were made on each fraction with respect to the mixture of activities of ^{76}Br, ^{13}N, and ^{60m}Co produced together, and with respect to content of bromine. The ligand yields varied with the kind of ligand X. Comparison was made of the behavior of hot ^{76}Br atoms resulting from (n,2n) process with that of ^{80m}Br, and ^{82}Br atoms arising from (n,γ) process. The dependencies of the ligand yields in (n,2n) and (n,γ) cases on the properties of the ligand X were compared and found to be very much alike for both nuclear processes. It was concluded that the large difference in maximum recoil energies of hot atoms does not play a dominant role in deciding the fate of recoiling radiobromine atoms in these particular reactions. (D.H.M.)

24058 REACTIONS OF BROMINE ACTIVATED BY (n,γ) AND (I.T.) PROCESSES IN CARBON TETRACHLORIDE AND THE C_6-ALKANES. Merrigan, Joseph Andrew. Lincoln, Neb., Univ. of Nebraska, 1966. 207p.

Thesis.

The role of ^{82m}Br in liquid CCl_4 and the C_6-alkanes is defined. Bromine-82, activated by isomeric transition of ^{82m}Br, was found to react chemically in CCl_4, several alkyl halides, and the C_6-alkanes. A method of studying these reactions, independently of (n,γ)-activated reactions, was developed. By freezing samples to suppress (n,γ)-induced organic reactions during neutron irradiation, and thawing immediately after irradiation, the ^{82m}Br (I.T.) ^{82}Br-activated reactions in the liquid state were studied. The results of ^{81}Br (n,γ) ^{82m}Br activations in liquid systems were studied by freezing samples immediately after irradiations of various periods and extrapolating plots of ^{82}Br organic yields to zero time when they represented the ^{82m}Br yields. The organic yields induced by $^{79}Br(n,\gamma)^{80m}Br$, $^{81}Br(n,\gamma)^{82m}Br$, and $^{81}Br(n,\gamma)^{82}Br$ reactions were within experimental error of each other at given concentrations of Br_2 in a given solvent. The yields due to ^{82m}Br (I.T.) ^{82}Br reactions were 1.7 to 1.8 times the (n,γ)-induced yields at Br_2 concentrations above 0.05 mF in all systems. Thus, as ^{82m}Br decayed, the organic yield of ^{82}Br increased from the (n,γ) value to the value for (I.T.)-activated reactions. The contribution of ^{82m}Br (I.T.) ^{82}Br reactions to observed isotope effects was studied and compared with ^{80m}Br (I.T.) ^{80}Br results reported by other laboratories. No isotope effects were found between (n,γ)-activated reactions, possibly none between (I.T.)-induced reactions, but a definite and pronounced isotope effect between (n,γ) and (I.T.)-activated reactions of bromine. Since this was the case, the decay of ^{82m}Br was responsible for much of the discrepancy in results reported in the past. The effects of degassing, sample purity, light, thermal reactions, radiation damage, counting rates, and freezing of samples before and after irradiation were studied. Scavenger curves for ^{80m}Br, ^{82m}Br, and ^{82}Br activated by radiative neutron capture and ^{82}Br activated by isomeric transition were obtained. Product distributions were found by using a radio-gas chromatograph, which was built for this work. Isomeric transition and radiative neutron capture yielded identical product distributions. The products and scavenger curves were related to structural and radiation properties of solvent molecules. There was a direct correlation between the structure of a molecule and products formed from it. It was also found that the organic yield at a given Br_2 concentration, was proportional to the G value for

total organic radicals produced by x rays in the region of the C_6-alkane G values. Existing theories and hypotheses of the mechanisms of bromine reactions activated by nuclear transformations were evaluated in light of the experimental results. The Auger electron reaction hypothesis gave the best correlation to experimental data. (Diss. Abstr.)

Separation Processes

Refer also to abstracts 23813, 23911, 24823, and 25093.

24059 (ANL-6994) ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 10. BENCH-SCALE STUDIES ON IRRADIATED, HIGHLY ENRICHED, URANIUM-ALLOY FUELS. Chilenskas, A. A.; Turner, K. S.; Kincinas, J. E.; Potts, G. L. (Argonne National Lab., Ill.). Oct. 1966. Contract W-31-109-eng-38. 43p. Dep. CFSTI.

A series of six experiments on irradiated uranium–Zircaloy and uranium–aluminum alloy fuels using fluid-bed fluoride volatility (FBV) processing techniques has been completed. These experiments were performed to determine the distribution of uranium and fission products following the various process steps and to indicate what decontamination factors can be realized. A hydrochlorination step was employed to remove the zirconium or aluminum from the uranium in the fluid-bed reactor. A fluorination step was employed (using fluorine) to volatilize the uranium as UF_6. A packed bed of granular alumina downstream of the fluid-bed reactor removed particulate matter entrained in the process gas, and beds of NaF pellets were used for additional decontamination. The retention of uranium in the reactor bed and the filter bed following the processing of irradiated uranium–Zircaloy or uranium–aluminum alloy was less than 1%, which is acceptable and comparable to that found in processing nonirradiated uranium alloys. Decontamination factors for the activities Ce, Sr, Cs, Ru, Sb, Zr, and Nb from uranium ranged from 3.5×10^3 to 1×10^8 for the final two experiments. The decontamination from gamma activity for these two runs was high and such that the principal gamma activity found with the product was due to ^{237}U. The decontamination factor for tellurium was 5.9×10^4; the factors for Mo, Tc, and Np were 44.6, 2.9, and 3.5, respectively. The distribution of fission products following hydrochlorination showed the principal volatile fission products to be Zr, Nb, Kr, and I. The activities that are only partially volatile (<10%) are Sb, Te, Mo, and Tc. The activities that are nonvolatile are Ce, Cs, Sr, and Ru. The distribution of the fission products following fluorination showed the highly volatile fission products to be Sb, Mo, Tc, Np, Nb, and Te. A small amount of zirconium was transported, probably by volatilization, from the reactor. The activities Ce, Cs, Sr, and Ru were essentially nonvolatile. (auth)

24060 (BNWL-SA-942) THERMAL EFFECTS IN PACKED BED PROCESS. Van Slyke, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1965]. Contract AT(45-1)-1830. 6p. (CONF-661025-3). Dep. CFSTI.

From Pacific Northwest Regional Meeting, American Institute of Chemical Engineers, Richland, Wash.

Chemical and engineering studies were made to discover how and why fires and explosions involving nitric acid and organic anion exchange resins in radiochemical processing occurred. The time–temperature–location behavior for packed-bed processes can be calculated from fundamental experimental data. These calculations show that even quite minor heat-producing processes can produce seriously high temperatures under certain conditions where flow rates, chemical concentrations, and systems thermal properties match unfavorably. The computer program can be adapted to other packed bed processes requiring a detailed thermal analysis. (M.C.G.)

24061 (EUR-3277.f) RECUPERATION DES TERRES RARES ET DU STRONTIUM DES SOLUTIONS ACIDES DE PRODUITS DE FISSION A L'AIDE DE DERIVES ORGANOPHOSPHORES. (Recovery of Rare Earths and Strontium From Acid Solutions of Fission Products by Means of Organophosphorus Derivatives). Galaud, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 17, 1967. 20p. (In French). Dep.

Some organophosphorus compounds of the phosphonate and phosphine oxide type have been studied by liquid-liquid extraction techniques and separation chromatography on a porous solid impregnated with extractant. Some compounds suggest interesting possibilities of recovery of rare earths whose behavior has been controlled by means of cerium. None of the compounds tested can be considered for strontium. (auth)

24062 (GAT-P-40) PRELIMINARY OPERATIONS AND PROCEDURES FOR UF_6 FEED MANUFACTURING FACILITY: BUILDING X-344, PORTSMOUTH AREA GASEOUS DIFFUSION PLANT. (Goodyear Atomic Corp., Piketon, Ohio). Feb. 17, 1967. Contract AT(33-2)-1. 150p. Dep. CFSTI.

Equipment for the conversion of UF_4 to UF_6 and generation of fluorine in the X-344 Feed Plant are described. Included are: liquid HF transfer systems, liquid HF storage tank vent; HF vapor system; fluorine system; fluorine auxiliary systems; reactor tower systems; solid materials systems; brine systems; refrigeration systems; miscellaneous systems; and instruments and rectifier systems for process control. (P.C.H.)

24063 (GAT-Z-439(Vol.1)(Excerpt)) X-344 FEED MANUFACTURING FACILITY. (Goodyear Atomic Corp., Piketon, Ohio). Feb. 17, 1967. Contract AT(33-2)-1. 34p. Dep. CFSTI.

The X-344 Facilities produce UF_6 feed material from the green salt UF_4, and together with the X-342 Feed Vaporization Plant. Descriptions are given for the design of: X-344A, Feed Manufacturing Plant, comprising the major added structure and the new fluorination facility and components; X-344B, the Ash Storage Building; X-344C, comprising the Hydrogen Fluoride Storage Yard; X-344D, HF Neutralization Pit; and X-344E, Gas Ventilation Stack. (P.C.H.)

24064 (HW-69910) STUDIES OF DIBUTYL BUTYL PHOSPHONATE AS AN EXTRACTANT FOR PLUTONIUM FROM THE RECUPLEX WASTE STREAM. Kingsley, R. S.; Crocker, H. W. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). June 15, 1961. Contracts AT(45-1)-1350; W-31-109-eng-52. 20p. DTIE.

Extraction coefficients for Pu in the CAW stream (5 mg/l Pu) using 25% dibutyl butyl phosphonate (DBBP)–75% CCl_4 as an extractant ranged from 160 to 250, or approximately 10 times better than those for 20% TBP–80% CCl_4. The 25% DBBP consistently removed 94 to 96% of the Pu waste from the CAW in one stage. The most promising agents for stripping Pu from DBBP were found to be 5% Na_2CO_3 or 1 M HF. A preliminary flow sheet for a static DBBP column is presented. (P.C.H.)

24065 (KFK-502) STUDIEN UEBER DIE KERNTECHNISCHE ANWENDUNG DER KOLONNENKRISTALLISATION UND VERGLEICH MIT DEM ZONENSCHMELZVERFAHREN. (Studies on Nuclear-Technology Application of Column Crystallization and Comparison With Zone-Melting Methods). Ammon, R. v. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). Oct. 1966. 30p. (In German). Dep. mn.

Zone melting and column crystallization were compared as methods for separation in the system KNO_3–$NaNO_3$, the binary eutectic KCl–LiCl, the ternary eutectic $MgCl_2$–NaCl–KCl, and the binary eutectic UCl_4–KCl. The results showed that both purification methods are in principle well suited for inorganic fused salt separations. Both methods have advantages and disadvantages. Zone melting is well suited for fine purification of sensitive substances but requires a long period of time and can handle only small amounts. Column crystallization on the other hand is rapid and is suitable for large throughputs. It has the best separation efficiency in systems in which the components are in large concentrations. It has, however, great mechanical problems for melts with high freezing points and high corrosion. (J.S.R.)

24066 (KR-115) FEED ADDITIVES: AN ATTEMPT TO IMPROVE THE DECONTAMINATION OF U BY COMPLEXATION OF FISSION Zr–Nb AND Ru IN NITRIC ACID SOLUTIONS OF SPENT REACTOR FUEL. Joon, K.; Deurloo, P. A. (Institutt for Atomenergi, Kjeller (Norway)). Dec. 1966. 39p. Dep.

An attempt was made to reduce fission product extraction from nitric acid solutions of spent reactor fuels into TBP by complexation of these elements in the aqueous phase. Laboratory-scale experiments were carried out in relation to the Purex process with modified process solution. Attention was focussed on the behavior of Ru and Zr/Nb. Pre-extraction treatments were carried out with oxalic acid, EDTA, sulfosalicylic acid, thoron, Arsenazo I, benzohydroxamic acid, chromotropic acid, tiron, thiourea, tartronic acid, citric acid, barbituric acid, DTPA, mandelic acid, and phenylarsonic acid, under different conditions of acidity, temperature and time of the treatment, and reagent concentration. Attention is given also to the influence of the treatment on Pu extraction and to the influence of the time-lapse between the end of the treatment and the subsequent extraction on the extractability of Zr/Nb, Ru, and Pu. Thoron, benzohydroxamic acid, mandelic acid, and phenylarsonic acid are not suited for the purpose because of a largely increased Zr/Nb extraction. The other complexing agents gave promising results with respect to either Ru or Zr/Nb extraction or to both. Pu extraction was unfavorably influenced by oxalic acid, tartronic acid, tiron, and barbituric acid. (auth)

24067 (NIRS–5, pp 10-16) CHEMISTRY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Research progress is reported on: separation of ^{90}Sr and ^{90}Y by paper electrophoresis; separation of Na, K, Rb, and Cs by thin-layer chromatography; separation of radiocesium using copper ferrocyanide anion exchange resin; synthesis and reactivities of N-ethyl-AET derivatives; NMR study of poly-D-glutamic acid; reactions of amino acids and related substances with pyridoxal; and ^{210}B determination in human lung by electrochemical displacement. (M.C.G.)

24068 (ORNL–P–2961) HYPERFILTRATION WITH DYNAMICALLY-FORMED MEMBRANES. Kraus, Kurt A.; Shor, Arthur J.; Johnson, James S. Jr. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 38p. (CONF-670509–1). Dep. CFSTI.

From 2nd European Symposium on Fresh Water from the Sea, Athens, Greece.

The dynamic formation of salt-rejecting membranes on porous supports from appropriate additives in the feed solutions is discussed. Requirements of membranes for salt rejection are reviewed. The properties of dynamic ion exchange membranes are demonstrated using ZrO_2. Other dynamic membranes, such as hydrous Fe_2O_3, humic acid, bentonite, organic polyelectrolytes, and polyvinyl pyridine are also discussed briefly. (P.C.H.)

24069 (PEL–121(Vol.1)) A DISCUSSION ON THE PROGRAMME OF THE EXTRACTION METALLURGY DIVISION, 1ST TO 3RD DECEMBER 1965. VOLUME I. Geertsma, J. C.; James, H. E.; Paynter, J. C.; Robinson, R. E. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 101p. Dep. mn.

Four articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 24070–24073.

24070 (PEL–121(Vol.1), pp 1-31) THE PRODUCTION OF HIGH-PURITY URANIUM AT A SOUTH AFRICAN GOLD MINE. Robinson, R. E.; (and others) (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The chemistry of the Bufflex solvent-extraction process is described. Uranium is extracted by a tertiary amine solvent, from which the impurities are removed by means of dilute ammonia, and the uranium is stripped by an ammonium sulfate strip. In the pilot plant these processes are carried out in mixer-settlers. Details of pumps, flow controllers, and materials of construction are given. The operation of the extraction, scrub, strip, precipitation and thickening, and regeneration sections is described. Comparative tests on the elution of ion exchange resin with 10% sulfuric acid and with nitrate are described. The results of resin analyses and plant tests are given. A breakdown of the costs of reagents in the Bufflex process, compared with the conventional process, is given. It was concluded that a solvent extraction process treating the sulfuric acid eluate from ion exchange columns is technically feasible. As regards the resin itself, elution with 10% sulfuric acid is satisfactory. There is more polythionate build-up than with nitrate elution, and the capacity of the resin is slightly lower, but the difference is small. The operating cost of the Bufflex process is cheaper by at least 5 cents per pound of U_3O_8 produced. (auth)

24071 (PEL–121(Vol.1), pp 40-54) THE PRODUCTION OF URANIUM TETRAFLUORIDE BY THE DRYWAY PROCESS. REPORT NO. 2. INVESTIGATION OF BUFFLEX ADU AS FEED MATERIAL FOR THE MOVING BED REACTOR PROCESS. James, H. E.; Paynter, J. C.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The possibility of using Bufflex ammonium diuranate (ADU) for the preparation of U_3O_8 pellets suitable for processing to UF_4 in a moving bed dryway plant, has been investigated. It has been shown that calcination at 490°C of Bufflex ADU (previously washed to contain 0.6% sulfate) would be cheaper than calcination at 725°C of unwashed Bufflex ADU and would result in a product with a greater reactivity towards both reduction and hydrofluorination processes. This product would be suitable for dryway processing in a moving bed as regards purity and reactivity but further tests will have to be done to produce the material in a suitable pelletized form. (auth)

24072 (PEL–121(Vol.1), pp 60-73) THE PRODUCTION OF URANIUM TETRAFLUORIDE BY THE DRYWAY PROCESS. REPORT NO. 1. REVIEW OF PROCESSING TECHNIQUES. James, H. E.; Paynter, J. C.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Past and present processing techniques for the production of uranium tetrafluoride by the dryway process are reviewed. The moving-bed process, used in Canada and France, has an economic advantage over the process used in the U.S.A., where a fluidized-bed reactor is used for reduction and a stirred-bed reactor for hydrofluorination. (auth)

24073 (PEL–121(Vol.1), pp 74-92) DESIGN OF A 400 TON/ANNUM URANIUM REFINING PLANT. REPORT NO. 4. DESIGN AND COST ESTIMATES FOR A PLANT TO PRODUCE URANIUM TETRAFLUORIDE BY THE MOVING BED REACTOR PROCESS. Paynter, J. C.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The manufacturing cost for converting nuclear grade U_3O_8 to UF_4 by the moving-bed dryway process has been estimated to be 0.154, 0.122, and 0.106/lb U for plant capacities of 400, 1000, and 3000 tons/annum, respectively. (U basis). (auth)

24074 (PEL–121(Vol.2)) A DISCUSSION ON THE PROGRAMME OF THE EXTRACTION METALLURGY DIVISION, 1ST TO 3RD DECEMBER 1965. VOLUME II. Geertsma, J. C.; MacMillan, I.; Paynter, J. C.; van Rensburg, J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 127p. Dep. mn.

Six articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 24075–24080.

24075 (PEL–121(Vol.2), pp 95-109) FLUOROX PROCESS: PRODUCTION OF URANIUM HEXAFLUORIDE (UF_6) IN A FLUIDISED-BED REACTOR. REPORT NO. 1. CONSTRUCTION AND INITIAL EXPERIMENTAL WORK ON A PLANT TO PRODUCE 2 LB/HR UF_6. Geertsma, J. C.; Paynter, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The chemistry, equipment, and operation of the Fluorox Process for production of UF_6 are described. Considerable trouble was encountered in operating the fluidized-bed reactor because of difficulties in maintaining adequate fluidization and prevention of mechanical blockages by sintered powder. It is believed that these difficulties can be overcome by appropriate changes in design and operating conditions. It was found that at 800°C corrosion problems do not seem to be a limiting factor. (P.C.H.)

24076 (PEL–121(Vol.2), pp 110-25) FLUOROX PROCESS: PRODUCTION OF URANIUM HEXAFLUORIDE (UF_6) IN A FLUIDISED-BED REACTOR. REPORT NO. 2. FURTHER EXPERIMENTAL WORK ON THE FLUOROX PLANT. MacMillan, I.; Paynter, J.; van Rensburg, J.; Geertsma, J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

During the period from June 1964 to April 1965, 160 pounds of uranium hexafluoride were produced. A number of minor modifications were made to the plant, most of which were made in an attempt to reduce the sintering tendency of the fluidized bed. The problem of sintered beds was the major operational difficulty. As yet, little information has been found on why the sintering occurs. However, operating conditions at which the bed is least likely to sinter have been found. (auth)

24077 (PEL–121(Vol.2), pp 126-51) FLUOROX PROCESS: PRODUCTION OF URANIUM HEXAFLUORIDE (UF_6) IN A FLUIDIZED-BED REACTOR. REPORT NO. 3. FINAL EXPERIMENTAL WORK ON THE 4 IN. DIAMETER FLUIDISED-BED REACTOR. MacMillan, I.; Paynter, J.; van Rensburg, J.; Geertsma, J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

During the period from May to September, 1965, 87 pounds of uranium hexafluoride were produced. The reasons for sintering of the fluidized bed were investigated. The high concentration of fine particles and the high local concentration of uranium tetrafluoride were found to be the main cause. A feed material that had been pretreated to cover the UF_4 particles with a thin skin of UO_2F_2 was tried. This successfully reduced the sintering in the feed pipe. Operating at a temperature of 810°C improved the conversion considerably, but increased the corrosion to such an extent that the reactor corroded through in about 50 hours. (auth)

24078 (PEL–121(Vol.2), pp 152-69) FLUOROX PROCESS: CONVERSION OF URANYL FLUORIDE (UO_2F_2) TO URANIUM TETRAFLUORIDE (UF_4). MacMillan, I. C.; Paynter, J. C.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The problems associated with converting the UO_2F_2 discharged from the Fluorox reactor to UF_4 suitable for reprocessing in the Fluorox reactor have been investigated. The most economic and technically suitable process involves the dryway conversion of UO_2F_2 by the standard reduction and hydrofluorination techniques. A side stream of UO_2F_2 is dissolved in water to remove impurities from the process, and then returned as UO_2F_2 pellets. Experimental work confirmed the feasibility of the main features of this process. (auth)

24079 (PEL–121(Vol.2), pp 178-95) DESIGN OF A 400 TON/ANNUM URANIUM REFINING PLANT. REPORT NO. 3.

CONCEPTUAL DESIGN OF A MOVING-BED REACTOR PLANT FOR THE PRODUCTION OF URANIUM HEXAFLUORIDE BY THE FLUOROX PROCESS. Paynter, J. C.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The relative merits of fluidized-bed and moving-bed techniques for the production of UF_6 by the Fluorox process have been compared. The moving-bed process is preferred for technical and economic reasons, and a conceptual plant design has been prepared. A comparison of this process with the conventional fluorination process suggests that it may prove to be a cheaper route for the production of UF_6. It is recommended that the moving-bed process should be investigated. (auth)

24080 (PEL–121(Vol.2), pp 205-19) DESIGN OF A 400 TON/ANNUM URANIUM REFINING PLANT. REPORT NO. 2. INTERIM ECONOMIC EVALUATION AND COMPARISON OF VARIOUS URANIUM REFINING PROCESSES. Paynter, J. C.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The cost of manufacturing nuclear-grade U_3O_8, UO_2, UF_4, and UF_6 can be reduced by using U_3O_8 produced from Bufflex type ammonium diuranate (ADU). This could mean that it would be possible to produce nuclear-grade uranium products on a relatively small scale in South Africa, at a price competitive with the large uranium refiners overseas. The moving-bed dryway process using Bufflex ADU as a feed material is the cheapest process for the production of UF_4. The conventional dryway process of UF_6 production as used overseas is more expensive than the "French process" using Bufflex ADU as feed material. The raw material plus utilities costs of the Fluorox and fluorination process for the production of UF_6 from UF_4 are comparable. At the present stage of development of the Fluorox process the capital and labor costs are similar to those for the fluorination process, but there is a possibility that the capital cost of the Fluorox process can be reduced by simplifying the process. (auth)

24081 (PEL–121(Vol.3)) A DISCUSSION ON THE PROGRAMME OF THE EXTRACTION METALLURGY DIVISION, 1ST TO 3RD DECEMBER 1965. VOLUME III. Geertsma, J. C.; Hart, H. P.; Jacobs, I. D.; Marran, J.; Paynter, J. C.; Steele, T. W.; Tunley, T. H.; van Rensburg, A. J. J.; Venter, V.; Watson, A. E. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 106p. Dep. mn.

Five articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 24082–24084, 24730, and 24731.

24082 (PEL–121(Vol.3), pp 222-33) PULSE COLUMNS IN URANIUM REFINING. SOME ENGINEERING ASPECTS OF THEIR OPERATION IN THE GOVERNMENT METALLURGICAL LABORATORY. Hart, H. P.; Tunley, T. H. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Flooding rates were determined for the extraction and strip pulse columns used in refining uranium. The maximum throughput of the 3 in.-diameter columns was of the order of 150 ft/hr. Measurements of the Height of a Transfer Unit (H.T.U.) for the extraction column were determined and found to vary from 1.8 to 2.5 ft, depending on the positions in the column. (auth)

24083 (PEL–121(Vol.3), pp 234-43) SOLVENT EXTRACTION OF CRUDE URANIUM CONCENTRATE BY TRIBUTYLPHOSPHATE TO PRODUCE A NUCLEAR-GRADE SOLUTION. Tunley, T. H.; Hart, H. P. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Work carried out to provide data for the design of a large scale plant, especially the solvent extraction section for the production of nuclear-grade uranium solutions, is described. The feasibility of the operation has been proved, and the plant has been used to produce substantial quantities of nuclear-pure solution. (P.C.H.)

24084 (PEL–121(Vol.3), pp 246-65) THERMAL DECOMPOSITION OF AMMONIUM URANOUS FLUORIDE TO URANIUM TETRAFLUORIDE IN A FLUIDIZED BED. REPORT NO. 2. PROGRESS REPORT ON EXPERIMENTAL WORK ON A 30-INCH DIAMETER FLUIDIZED-BED REACTOR. Venter, V.; Paynter, J. C.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The pilot plant for the thermal decomposition of ammonium uranous fluoride has worked satisfactorily during the past 15 months. A total of 26 batches had been treated giving uranium tetrafluoride content (expressed as ppMN) consistently less than 20 ppM. Modifications to the equipment have been made in order to improve operations. For example, porous metal filters are now used in place of the cyclone. (auth)

24085 (PEL–121(Vol.4)) A DISCUSSION ON THE PROGRAMME OF THE EXTRACTION METALLURGY DIVISION, 1ST TO 3RD DECEMBER 1965. VOLUME IV. Birkhill, R. S.; Geertsma, J. C.; Muir, C. W. A. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 108p. Dep. mn.

Two articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 24086 and 24087.

24086 (PEL–121(Vol.4), pp 327-400) COMPILATION OF REPORTS ON ADU PRECIPITATION AND URANIUM OXIDE PRODUCTION TO 31ST OCTOBER 1965. Birkhill, R. S.; Geertsma, J. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Methods for the production of sinterable UO_2 powder are described and evaluated. The precipitation of ammonium diuranate (ADU) for the production of uranium dioxide (UO_2) is considered first. It was concluded that the projects have now reached the stage where UO_2 can be produced at a rate of about 15 lb/hr. Chemical engineering aspects of the process are also evaluated. Basic research done on the reactions involved in the preparation of UO_2 are described. The main emphasis is on the reduction of U_3O_8 to UO_2 in hydrogen, which has been investigated on a thermobalance. Reference is also made to the composition and structure of ADU prepared in the pilot plant. (P.C.H.)

24087 (PEL–121(Vol.4), pp 411-31) FRENCH PROCESS: FUNDAMENTAL. REPORT NO. 3. THE PRECIPITATION OF AMMONIUM URANOUS FLUORIDE: BENCH-SCALE KINETIC TESTS. Muir, C. W. A. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Chemical and infrared spectrophotometric methods were used to analyze the off-gas from the reaction in which sulfur dioxide is bubbled into a heated solution containing ammonium fluoride and formic acid with or without the presence of uranyl ions. It was found that carbon dioxide is evolved for a relatively short period at a constant rate during the lengthy reaction between sulfur dioxide and formic acid. It is believed that the accompanying constant production of a reducing agent that is capable of reducing uranyl ions is responsible for the zero-order characteristics that have been found when precipitating ammonium uranous fluoride from such a system. From the qualitative observations made when studying off-gas evolution by infrared spectrophotometric methods, several suggestions have been made that might make the process more attractive economically. (auth)

24088 (PEL–121(Vol.5)) A DISCUSSION ON THE PROGRAMME OF THE EXTRACTION METALLURGY DIVISION, 1ST TO 3RD DECEMBER 1965. VOLUME V. Groenewald, T.; Laxen, P. A.; Lloyd, P. J.; Steele, T. W.; Stoch, H.; Watson, A. E. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 146p. Dep. mn.

Eight articles are included; separate abstracts were prepared for 6. The 2 articles not included in NSA contain information on the extraction of anionic and neutral nitrate complexes of nitrosyl ruthenium and a list of lectures to Pretoria University on nuclear chemical engineering. (P.C.H.)

For abstracts of individual papers see: 23822–23824 and 24089–24091.

24089 (PEL–121(Vol.5), pp 434-75) LEACHING FUNDAMENTALS. REPORT NO. 2. THE DISSOLUTION OF URANIUM METALS FROM SOUTH AFRICAN ORES IN ACID SOLUTIONS. Laxen, P. A. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

The dissolution of uranium minerals from South African ores was studied by leaching a very small weight of ore, for example 10 g, in a large volume of solution, 1000 ml, made up to a definite concentration of H_2SO_4 and Fe^{3+}. When this method was used, it was found that the different ores had little or no effect on the concentrations of the reagents in the leach solution. It was also established that the ore samples that gave poor extractions of U contained U whose dissolution was adversely affected by Fe^{2+} in solution and by the presence of phosphate. From tests on primary uraninite concentrates, it was found that these effects were not on the primary uraninite in these ores. The presence of secondary uraninite in the ores that leached poorly was confirmed by the size distribution shown by U. The kinetics of the dissolution of uraninite were investigated, and a mechanism for the dissolution of this mineral in ferric sulfate–sulfuric acid solutions is suggested. (P.C.H.)

24090 (PEL–121(Vol.5), pp 476-90) A COMBINED URANIUM–GOLD LEACHING PROCESS. REPORT NO. 1. EXAMINATION OF THE FEASIBILITY OF THE PROCESS. Groenewald, T.; Laxen, P. A. (Atomic Energy Board, Pelindaba, Pretoria South Africa)).

The feasibility of leaching gold and uranium simultaneously from ores containing both these metals was investigated. Samples of Blyvooruitzicht ore were leached in aerated solutions containing copper and cyanide made up in carbonate and bicarbonate medium. The process was examined in the temperature range from

25 to 90°C. A high percentage extraction of both gold and uranium was obtained. The rate of gold dissolution was such that even at ambient temperature, 96 to 97% extraction of gold was possible within 24 hours. The results indicate that a temperature of about 50 to 60°C would be required to obtain an extraction of uranium of between 85 and 90%, within the same period. The success of the results has encouraged a further investigation of the process involved in the combined leach of gold and uranium. (auth)

24091 (PEL-121(Vol.5), pp 496-501) PROGRESS REPORT ON THE SEPARATION AND RECOVERY OF GOLD AND URANIUM FROM LEACH SOLUTIONS. Lloyd, P. J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Preliminary tests were made on the recovery of Au and U from simultaneous leach solutions by Zn precipitation and solvent extraction, respectively. It was found that significant recovery of Au is possible from the combined-leach solutions by the conventional zinc precipitation method. Addition of Hg was found to be beneficial, and reduction of the zinc particle size helpful. The recovery of U by solvent extraction using Aliquat 336 carbonate appeared to be quite feasible. (P.C.H.)

24092 (SRO-122) CONSTRUCTION COST INFORMATION, NUCLEAR FUEL SERVICES, INC. PLANT, WEST VALLEY, NEW YORK. (Bechtel Corp., San Francisco, Calif.). June 21, 1966. Contract AT(38-1)-344. 23p. Dep. CFSTI.

Plant costs breakdown by process step for the spent fuel reprocessing plant is presented for 5 of the process steps. Price breakdown by functional unit is a breakdown of the "owner's price" and reflects construction costs. (M.C.G.)

24093 (ORNL-tr-1665) ANALYSIS OF THE BEHAVIOR OF A SALT-METAL EXTRACTION COLUMN FOR U-Bi FUEL. Miyauchi, Terukatsu; Takata, Masaru. Translated for Oak Ridge National Lab., Tenn. from Kagaku Kogaku, 26: 991-8(1962). 19p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

The analysis, methods, and equipment for the removal of fission products from fuel of the Liquid Metal Fuel Reactor (LMFR) using the three-component $NaCl-KCl-MgCl_2$ fused salt mixture (mp 396°C) to extract the fission products from the U-Bi fused metal fuel are described. Analyses were made of the extraction processes that take place within the oxidation section of the main extraction tower. These analyses were made with practical tower designs, and basic equations, which took the form of non-linear, multiple coupled equations, were derived. The results of the numerical analysis were compared with experimental data and similar trends were observed. These results were then used to determine the behavior of each component and its distribution within the tower. (P.C.H.)

24094 USE OF PRECIPITATION WITH IRON HYDROXIDE IN SEPARATING SMALL AMOUNTS OF AN ELEMENT. Novikov, A. I. (Tadzhik State Univ., Stalinabad, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, (11), Ser. Khim. Nauk, No. 3, 64-8(1965). (In Russian).

Experimental data are presented on the separation of the following groups or pairs of elements by iron hydroxide as a function of concentration, pH, time of contact, order of mixing the reagents, etc.: Y-Sr-Rb; La-Ba-Cs; Sc-Ca-K; Ta-W-Re; Te-I; Cd-In; Li-Be, and Nb-Mo. In separating ^{90}Y, ^{90}Sr and ^{86}Rb, iron hydroxide is precipitated by neutralizing with pyridine to a pH of 6.0. This fraction carries the ^{90}Y. After centrifuging off the precipitate, more iron carrier is added, and the pH is raised to >12 to precipitate the ^{90}Sr. The ^{86}Rb does not carry at any pH. The operation can be repeated a number of times to obtain any desired degree of purity. The La-Ba-Ca and the Sc-Ca-K separations are analogous to the Y-Sr-Rb separation. In and Cd can be separated by coprecipitating the In on $Fe(OH)_3$ at a pH of 4.5 to 6.0. The Cd goes into the filtrate. Be is completely precipitated on $Fe(OH)_3$ at a pH of 6.5 to 12, while Li remains in solution. Tellurium is separated from iodine by oxidizing with persulfate in an acid medium, and carrying the tellurate on $Fe(OH)_3$ at a pH >12. Iodate goes into the filtrate. Ta and W are separated from Re by precipitation on $Fe(OH)_3$ at a pH of 5 to 8. In order to separate Ta from W, the precipitate is dissolved in 0.1N HCl, and Ta is precipitated on $Fe(OH)_3$ by pouring the acid solution into concentrated NH_4OH. The Nb-Mo separation is analogous to the Ta-W separation. (TTT)

24095 SORPTION AND FIXATION OF MICROQUANTITIES OF CESIUM BY CLAY MINERALS: EFFECT OF SATURATING CATIONS. Sawhney, B. L. (Connecticut Agricultural Experiment Station, New Haven). Soil Sci. Soc. Amer., Proc., 28: 183-6(Mar.-Apr. 1964).

Sorption and fixation of ^{137}Cs in the presence of microquantities of Cs by 6 minerals, as affected by the saturating cations, were studied. Micas and vermiculite sorbed more Cs in the presence of Ca and other divalent cations than in the presence of K and other monovalent cations. Montmorillonite and kaolinite, on the other hand, sorbed more Cs in the presence of K than in the presence of Ca. While micas and vermiculite fixed a large proportion of the Cs sorbed, montmorillonite and kaolinite did not fix significant amounts of Cs against replacement by neutral salts. Thus, whereas Cs sorption by montmorillonite and kaolinite appeared to be largely electrostatic, the sorption and fixation of Cs by micas and vermiculite was governed by the size and hydration, rather than valence, of the competing cation. Micas particularly exhibited a large fixation of Cs. It is suggested that the fixation of Cs by micas occurs at the crystal edges where Cs may replace K and thus become a part of the stable mica structure. (BBB)

24096 EFFECT OF DILUENTS ON THE EXTRACTION OF RARE-EARTH ELEMENTS BY CARBOXYLIC ACIDS. Plaksin, I. N.; Strizhko, V. S.; Fedotov, Yu. S. Dokl. Akad. Nauk SSSR, 171: 1348-51(Dec. 21, 1966). (In Russian).

Some peculiarities in the reaction of diluents with aliphatic synthetic acids of the C_7-C_9 fraction in the extraction of La, Pr, Nd, and Gd were studied. The role of diluents depends essentially on the proton affinity, as well as the ability to form additional compounds with the acid molecules through hydrogen bonds of varying strength and polarity. Carboxylic acids and alcohols possess donor-acceptor properties with respect to hydrogen. Extraction is considerably less affected by diluents that are only proton acceptors in an acid-base reaction. Nonpolar diluents have the least effect. The diluents studied are listed in the following order as to their effect on extraction equilibrium and their ability to form hydrogen bonds: heptyl alcohol, decyl alcohol, isoamyl acetate, metaxylene, dichlorodiethyl ether, carbon tetrachloride, and kerosene. (JPRS)

24097 EXTRACTION OF NIOBIUM(V) BY TRI-n-BUTYL PHOSPHATE FROM STRONGLY ACID SOLUTIONS IN THE PRESENCE OF MASKING AGENTS. Konecny, Ctirad (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Radiochim. Acta, 6: 192-6(Dec. 1966).

Extraction of microamounts of niobium(V) by tri-n-butyl phosphate from hydrochloric and nitric acid media in the presence of various multidentate ligands which function as masking agents was studied with respect to the amounts of the ligand and to the hydrogen ion concentration. Separation of microamounts of niobium from hexavalent uranium was investigated. It was found that the most convenient chelating agents are oxalic acid, citric acid, EDTA, NTA, Tiron, pyrogallol-sulfonic acid and chromotropic salt. (auth)

24098 METHODS OF SEPARATING THE ACTINIDE ELEMENTS. Ulstrup, J. (Univ. of Denmark, Lyngby). At. Energy Rev., 4: No. 4, 3-82(Dec. 1966).

A survey of existing literature up to the early part of 1966 on the methods of separating the actinide elements is presented. The survey is complete for all elements except uranium and plutonium which are described generally because the literature on these two elements is very extensive. The methods of separation described are based partly on older principles such as fractional precipitation, distillation, or sublimation and partly on more modern principles such as solvent extraction, ion exchange, and various chromatographic procedures. Some of the latter were developed specifically for the actinide elements. The information is arranged according to the actinide element rather than the method of separation, because the methods applied vary from one element to another and several methods are often used for the isolation of one particular element. Nuclear properties of the actinide elements are briefly mentioned where they are directly related to the actual method of separation; isotopic separations are not described. (420 references.) (auth)

24099 EXTRACTION OF SCANDIUM(III) WITH TRI-n-BUTYL PHOSPHATE FROM AQUEOUS CHLORIDE SOLUTIONS. Morris, D. F. C.; Sutton, K. J. (Brunel Univ., London). Bull. Chem. Soc. Jap., 40: 786-7(Apr. 1967).

The distribution of scandium(III) between tri-n-butyl phosphate and aqueous solutions containing chloride was measured using ^{46}Sc as a tracer. The extraction of anionic scandium chlorocomplexes seemed unimportant in the systems studied. It appeared that different solvates of the trichloride $ScCl_3$ can exist in tributyl phosphate extracts. (auth)

24100 RECOVERY OF URANIUM AND PLUTONIUM VALUES FROM AQUEOUS SOLUTIONS OF AMMONIUM FLUORIDE, PARTICULARLY FROM ZIRFLEX-TYPE WASTE SOLUTIONS. (to U. S. Atomic Energy Commission). British Patent 1,061,497. Mar. 15, 1967. Priority date July 6, 1964, United States.

A process for recovering U and/or Pu from an aqueous ammonium fluoride solution also containing Zr comprises adding a soluble peroxide to the solution until the solution is 1M in hydrogen peroxide to precipitate the U and Pu as insoluble peroxides prior to any Zr precipitation. (B.L.M.)

24101 SEPARATION OF RADIOACTIVE IONS. Riesenhuber, Heinz; Grossmann, Dietrich. British Patent 1,064,444. Apr. 5, 1967. Priority date Mar. 20, 1963, Germany.

A process for separation of radioactive ions from solutions consists of passing the solutions through a filter on which is disposed a sparingly soluble salt of the ion consisting of nonradioactive isotopes. The filter is preferably a membrane filter, and the solution is passed through the filter at a velocity of 1 to 100 ml/cm^2/min. (B.L.M.)

24102 IMPROVEMENTS IN OR RELATING TO THE RECOVERY OF BORIC ACID. Burton, William Robert (to United Kingdom Atomic Energy Authority). British Patent 1,064,232. Apr. 5, 1967. Filed Jan. 31, 1964.

A process for the recovery of boric acid consists of passing the aqueous solution through a basic ion exchange resin on which the boric acid is taken up, washing the resin with aqueous ammonia to remove the boric acid from the resin, and boiling the effluent to drive off the ammonia. The aqueous ammonia is at least 4N, and the resin is maintained at a temperature between 50 and 60°C during the ammonia washing. The process is particularly applicable to the recovery of boric acid from an aqueous solution used in the core of a nuclear reactor. (B.L.M.)

24103 PROCESS FOR THE ISOLATION OF ^{32}P FROM IRRADIATED SULFUR. Radicella, Renato; Goso, Rogelio Pedro (to Comision Nacional de Energia Atomica). British Patent 1,066,066. Apr. 19, 1967. Filed Oct. 8, 1964.

A method for the isolation of ^{32}P from neutron-irradiated S comprises contacting a solution of the irradiated S with a material comprised of quartz or a Si-containing glass or ceramic and then recovering the ^{32}P retained by the material. Preferably, the retention material is in the form of particles having a diameter of from 0.3 to 1.0 mm. (B.L.M.)

24104 METHOD FOR DIRECT SEPARATION AND RECOVERY OF PLUTONIUM FROM IRRADIATED NUCLEAR FUEL. (to Japan Atomic Energy Research Inst.). British Patent 1,060,965. Mar. 8, 1967. Priority date Feb. 10, 1964, Japan.

A method is described for the recovery of Pu from irradiated nuclear fuels by pulverizing the fuel by repeated oxidation and reduction, mixing the pulverized fuel in the oxidized state with a high-molecular-weight alkyl tertiary amine nitrate, separating the resultant Pu-amine complex from the residue, and then precipitating the Pu as the oxalate with an oxalic acid solution. (B.L.M.)

24105 PROCESS FOR ELIMINATING FROM A SOLUTION ANIONS DERIVED FROM HYDRACIDS. Guth, Jean Louis; Wey, Raymond (to Commissariat a l'Energie Atomique). British Patent 1,063,259. Mar. 30, 1967. Priority date Jan. 27, 1964, France.

A process is described for extraction of anions derived from hydracids (acids not containing oxygen) at a high temperature under corresponding steam pressure. The solution containing the anions to be exchanged having an OH concentration in the vicinity of 0.1N is rendered slightly alkaline and is passed at a temperature of 200°C through an anion exchanger consisting of hydroxysodalite. (B.L.M.)

EARTH SCIENCES

Geology

Refer also to abstracts 24121, 24125, 24185, and 24242.

24106 CARBON ISOTOPIC DISTRIBUTION AND CORRELATED CHRONOLOGY OF SEARLES LAKE SEDIMENTS. Stuiver, Minze (Yale Univ., New Haven). Amer. J. Sci., 262: 377-92(Mar. 1964).

Problems associated with the determination and analysis of ^{13}C and ^{14}C data for age estimation of lake sediments are presented in the course of studies on Searles Lake, in southeastern California. Also examined was the sequence that led to the striking succession of evaporites and mud, especially the climatic phenomena and the possible resulting changes in carbon isotopic distribution in the sediments. The layer of evaporites forming the Upper Salt consists chiefly of halite, hanksite, trona, and borax; the thickness from the Parting Mud to the surface varies from 18 to 27 m. The Parting Mud revealed differences in the ages of the carbonate and organic fractions. As the fractions are corrected for isotopic fractionation, the same age is expected because during time of deposition both fractions should have had identical radiocarbon contents. The differences found must therefore postdate deposition of the sediments; this may have been through diagenesis or simply by contamination with recent radiocarbon during handling of the sample. Contamination with recent radiocarbon was shown to readily occur when the core was brought to the surface and exposed to the air, with carbon dioxide being exchanged with (or even added to) the carbonaceous material of the core. Thus, a sample of Parting Mud spread over a large surface and exposed for 3 weeks to a normal atmospheric environment showed an increase in radiocarbon activity for the carbonate fraction corresponding with an exchange (or addition of) 5.6% of the total amount of carbon. Equations were derived for determining diffusion of radiocarbon through mud. For the Parting Mud a diffusion constant for radiocarbon of 14×10^{-10} cm^2/sec was found. Carbon-13 ratios of the organic material did not show any systematic trend with depth. All ^{13}C ratios were within intervals −22.8 to −26.2 per mill, which are variations of an order of magnitude encountered in nature for this type of sediments. (BBB)

24107 SULFUR-ISOTOPE GEOCHEMISTRY OF PETROLEUM, EVAPORITES, AND ANCIENT SEAS. Thode, H. G.; Monster, J. (McMaster Univ., Hamilton, Ont.). pp 367-77 of Fluids in Subsurfaces Environments: A Symposium, Memoir No. 4. American Association of Petroleum Geologists, 1965.

Data relating to S-isotope geochemistry are compiled and reviewed. It has now been established that considerable S-isotope fractionation occurs in the biological S cycle and that the bacterial reduction of sulfate, which leads to the enrichment of ^{34}S in sulfate and its depletion in sulfide, is largely responsible for the wide fluctuations in isotope ratio which occur in marine sediments. Present-day ocean-water sulfate is remarkably uniform in S-isotope content, both in depth and in geographical location at a value of $\delta\ ^{34}S = +20$ (20 parts per mil enriched ^{34}S with respect to S in meteorites), and provides a base level in isotope ratio from which fractionation can be reckoned. However, in dealing with ancient sediments and petroleum, the ^{34}S content of the ancient oceans or seas must be determined. From a study in the S-isotope distribution in the marine evaporites of 10 sedimentary basins of several continents, it was possible to estimate the S-isotope ratio for the various ancient oceans and to establish the pattern of geologic change. The pattern of change for petroleum S appears to be parallel to that for the evaporites and ancient seas. However, the petroleum S is, in general, depleted in ^{34}S by about 15% with respect to the contemporaneous gypsum and anhydrite deposits. This displacement of 15% in the ^{34}S content, which is about the isotope fractionation expected in the bacterial reduction of sulfate, is strong evidence that seawater sulfate is the original source of petroleum S and that it is first reduced by bacterial action in the shallow muds before being incorporated into petroleum. The lack of any S-isotope fractionation in the plant metabolism of sulfate rules out plant S as a major source of petroleum S. (BBB)

24108 RADIOACTIVITY OF THE AIR IN THE SERVICE OF METEOROLOGY AND PHYSICS OF THE ATMOSPHERE. Blanc, Daniel; Fontan, Jacques (Faculte des Sciences, Toulouse). Mem. Acad. Sci. Toulouse, 128: 41-55(1966). (In French).

Measurements of natural and artificial radioactivity of the air which have led to advances in meteorology and better understanding of physics of the atmosphere are reviewed. Cosmic radiation-induced formation of ^{14}C, ^{3}H, ^{7}Be, ^{32}P is discussed as well as the terrestrial origin of Rn and thoron (Tn), and the thermonuclear explosion origin of various other radionuclides. Studies of atmospheric diffusion at low altitudes based on measurements of Rn and Tn are described, and effects of meteorologic factors on the results are considered. Measurements of air radioactivity over Toulouse and over the North Atlantic could be correlated with movements of air masses. Exchange of natural and artificial radioelements between the troposphere and stratosphere is also dealt with. (BBB)

24109 ANOMALIES IN THE $^{230}Th/^{232}Th$ ACTIVITY RATIO IN SOME MISSISSIPPI RIVER SEDIMENTS. Noakes, J. E. (Oak Ridge Associated Universities, Tenn.); Supernaw, I. R.; Akers, L. K. J. Geophys. Res., 72: 2679-82(May 15, 1967).

Unusually high $^{230}Th/^{232}Th$ activity ratios have been found in the fine sediment deposits of the Mississippi River in the Greenville, Mississippi, area. The ratio was approximately 4.0 during 1963 in this area, whereas a ratio of 1.0 or less was found in May 1965. The 1.0 value seems to be the natural background value for the entire valley. It is postulated that a natural source for this anomaly is unlikely. (auth)

24110 ISOTOPIC COMPOSITION OF VOLCANIC ARGON. Vinogradov, V. I.; Shanin, L. L.; Arakelyants, M. M. Dokl. Akad. Nauk SSSR, 170: 932-5(Oct. 1, 1966). (In Russian).

In view of the usual location of the magma chamber of volcanoes below the boundary of the earth's crust, the emitted gases were considered as representative for the outgassing of the mantle. This viewpoint is not generally accepted anymore. In order to clarify the problem of the origin of these gases, the emanations from fumaroles in the active volcanic regions of Kamchatka and Kuriles were examined, determining the isotopic composition of argon, collected in steel and quartz tubes, by means of a mass spectrometer. In the evaluation of the results it was kept in mind that argon from the earth's crust contains only ^{40}Ar while the atmospheric gas contains 0.337% of ^{36}Ar. The results indicated that the composition of the samples collected corresponded to atmospheric argon or differed from it only by at most 5%. It was therefore concluded that the fumarolic gases from the above regions are not enriched by radiogenic components, except to a slight extent; most of the gases were of atmospheric origin. (TTT)

24111 ISOTOPIC COMPOSITION OF LEAD FROM CARBONATE ROCKS OF DIFFERENT AGE. Gerling, E. K.; Iskanderova, A. D. Dokl. Akad. Nauk SSSR, 170: 905-7(Oct. 1, 1966). (In Russian).

As a result of its uranium and thorium content, the lead in carbonate rocks is usually "contaminated" by radiogenic isotopes; in radiochemical dating, this must be taken into account. In order to overcome this problem, the lead–uranium isochronic method, suggested previously for minerals containing large amounts of ordinary lead, was applied for the case of carbonate rocks, subjecting previously published and some unpublished data to mathematical analysis. The results of the calculations involving 3 groups of carbonate rocks of varying ages indicated that specimens of the same geological age lie on the same line; the absolute age determined by the slope of the isochronic lines agreed with values derived from geological and radiochemical tests of the rocks. Thus, the rocks represent a closed system as far as the uranium is concerned. The age obtained for Precambrian metamorphic rocks was higher than the age of metamorphosis, thus pointing out that it might be possible to determine the time of sedimentation and not the time of the subsequent metamorphosis of deposits. It was also found that the lead in the seawater is subject to the same isotopic composition changes as the terrestrial material. (TTT)

24112 ION DISTRIBUTION, MOISTURE CONTENT, AND DENSITY OF SOIL COLUMNS MEASURED WITH GAMMA RADIATION. Shalhevet, J.; Yaron, B. (Volcani Inst. of Agricultural Research, Rehovoth, Israel). Soil Sci. Soc. Amer., Proc., 31: 153-6(Mar.-Apr. 1967).

Anion distribution in soil columns was measured nondestructively by using a radioactive tracer, $^{60}Co(CN)_6^{3-}$. The breakthrough curves of Cl^- and $^{60}Co(CN)_6^{3-}$ were very similar, indicating the possible use of the ^{60}Co complex ion as a qualitative model for anion movement. The external measurement of gamma activity was compared to measurements of 1:1 water extracts of the sectioned columns. The gamma activity of the tracer was measured along uniformly packed soil columns through a few drying and wetting cycles. Drying was done with a stream of warmed air that passed around and through the perforated soil columns. Moisture content and density of the soil in the columns were measured simultaneously by the gamma attenuation method. An equation, the parameters of which were determined empirically,

giving density as a linear function of moisture content, may be introduced into the attenuation equation to correct for the variation of density with moisture content. (auth)

24113 TOTAL INSTRUMENTAL ANALYSIS OF ROCKS, PART B. OXYGEN DETERMINATION IN ROCKS BY NEUTRON ACTIVATION. Volborth, A. (Univ. of Nevada, Reno). Nev. Bur. Mines, Rep. 6B, 13p(1963).

Instrumentation and technical problems in determination of oxygen in geological samples by neutron activation analysis are discussed. Methods are described for estimation of the oxygen content of 2 basalts, 4 andesites, 2 rhyolites, Syenite 1a, and Diabase W-1, using Granite G-1 and distilled water as standards. The reaction $^{16}O(n,p)^{16}N$ was induced by a 14-MeV neutron flux produced by bombardment of a tritiated Ti target by a deuteron beam of 500 μa accelerated at 150 kV. The γ activity of the 7.5-sec ^{16}N was counted by a NaI(Tl) scintillation crystal and a 256-channel analyzer. The method described is fast and nondestructive. The precision achieved is 2 to 3% in relative deviation. Accuracy, based on 4 independent determinations, is about 1% of oxygen present, or 10 mg of oxygen in 2-g rock samples containing about 50% oxygen. (BBB)

Meteorology

Refer also to abstracts 24108, 24135, and 25048.

24114 (NAA-SR-11997(Vol.1)) CHARACTERIZATION OF AEROSOLS PRODUCED BY SODIUM FIRES. VOLUME I. SOLUTIONS OF A GENERAL EQUATION FOR THE COAGULATION OF HETEROGENEOUS AEROSOLS. Spiegler, P.; Morgan, J. G.; Greenfield, M. A.; Koontz, R. L. (Atomics International, Canoga Park, Calif.). May 1, 1967. Contract AT(04-3)-701. 35p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An IBM 7094 digital computer was used in solving the equation that describes in time the behavior of an aerosol. The topics investigated include coagulation of a heterogeneous aerosol, coagulation coupled with stirred settling, and an external source that continuously generates new particles. In some instances, approximations to the code results may be obtained, provided simplifying assumptions are made. The results indicate that the aerosol concentration is a more important parameter than the initial particle spectrum. (auth)

24115 (TO-B-64-12) MONTE CARLO PROGRAM FOR CALCULATING DOSES RESULTING FROM AN ISOTROPIC POINT SOURCE IN AN EXPONENTIAL ATMOSPHERE. Raso, Dominic J.; Woolf, Stanley (Technical Operations Research, Burlington, Mass.). Feb. 7, 1964. 42p.

For Lincoln Lab., Massachusetts Inst. of Tech., Lexington.

A Monte Carlo program was written for determining doses as a function of distances from a point isotropic source. The code is designed to compute fluxes resulting from scattered gamma rays in a given section of the atmosphere (11 km to 100 km) the density of which varies exponentially. A comparison of results with the moment method is made for the limiting case of a homogeneous medium. (auth)

24116 ENVIRONMENTAL IONIZING RADIATION IN DUNEDIN, NEW ZEALAND. Jamieson, H. D. (Wakari Hospital, Dunedin, N. Zeal.); Tripp, C. G. H.; Sanderson, F. L. N. Z. J. Sci., 9: 674-83(Sept. 1966).

To check local γ radiation levels following reports of high activity rock in the area, a portable scintillometer was calibrated and used to make measurements over an extensive area in Dunedin and in parts of Otago. Results were evaluated in terms of annual dose to gonads and bone marrow, and these values were compared with recent measurements made in the U. K. It was concluded that the Dunedin measurements were not significantly different from average γ radiation levels recorded elsewhere. Apart from variations in working situations, there were considerable variations between houses constructed of various materials, and also variations in the cosmic-ray dose rate over the range of altitudes where people live. For working situations, the range from mean to maximum was about 18 mrem/yr; for brick/wooden houses, the range of mean values was <7 mrem/yr, although differences between individual houses were higher. For cosmic-ray dose rates at occupied altitudes the variation was up to about 9 mrem/yr. There is nothing unusual about such variations. When the total yearly dose-rate to gonads or bone marrow from all natural sources was assessed, these variations were seen to be of smaller significance. These variations were compared with the value of 70 mrem/yr regarded as the maximum permissible increase in genetic exposure for the whole population when planning for nuclear power stations and other peaceful uses of atomic energy. Another comparison was made with the present contribution to the genetically significant dose by medical radiology in New Zealand. This dose, to the whole population, was assessed at 12 mrem/yr, and the corresponding bone marrow dose at ~20 to 40 mrem/yr. (BBB)

24117 ^{90}Sr IN THE AUSTRALIAN ENVIRONMENT DURING 1965. Fletcher, W. (United Kingdom Atomic Energy Authority, Capenhurst, Eng.); Gibbs, W. J.; Moroney, J. R.; Stevens, D. J.; Titterton, E. W. Austral. J. Sci., 29: 319-25(Mar. 1967).

Results of an Australia-wide survey made during 1965 and early 1966 directed at monitoring strontium-90 in fallout through the food chains to human bone tissue are reported. Eight new rainwater and soil monitoring stations were opened. Funnel ion exchange fallout samples were introduced at all monitoring stations. The mean annual deposition of ^{90}Sr remained in the region of 1m Ci/km^2. Strontium-90 increased in 1963 and 1964 but decreased during 1965 to the 1963 level. The mean ratio $^{90}Sr/Ca$ in total diet for 1965 is tabulated and compared to results of surveys from 1957 to 1964. Milk is responsible for 70% of the ^{90}Sr intake. The ratio $^{90}Sr/Ca$ in bone tissue increased in 1964 and 1965. Survey data indicate that fallout from past nuclear tests contributes no significant hazard to the health of the Australian population now or in the future. (F.S.)

24118 ESTIMATING THE EFFECT OF BUILDINGS ON PLUMES FROM SHORT STACKS. Culkowski, Walter M. Nucl. Safety, 8: 257-9(Spring 1967).

The behavior of plumes from short stacks near buildings is complicated by the shape of the building, surrounding terrain, and gustiness of the wind. Consequently the effective plume-source configuration can vary from that of an area source to a point source (elevated or ground level) in a matter of seconds. The conservative assumption of a ground-level point release as an upper limit is useful in estimating concentrations. (auth)

Mineralogy

24119 URANIUM AND OTHER TRACE ELEMENTS IN DEVONIAN AND MISSISSIPPIAN BLACK SHALES IN THE CENTRAL MIDCONTINENT AREA. Landis, E. R. U. S. Geol. Surv. Bull., 1107-E: 289-336(1962).

Woodford shale was assayed for U at 10 localities in Oklahoma. Uranium content ranged from less than 0.001 to 0.014%, but the modal, median, and arithmetic mean values of the Woodford samples as a whole and the samples of the shale only gave 0.001, 0.002, and 0.003% U, respectively. These values are probably representative of most of the Woodford except the phosphatic nodules and laminae had an average U content of 0.006%. In the Chattanooga shale sampled at 7 outcrop localities in Oklahoma, 10 in Arkansas, 1 in Missouri, and 2 in Kansas, U content ranged from less than 0.001 to 0.55%. Despite the low U contents of these formations as a whole, at one locality the Chattanooga shale contained 0.005% U in an interval 10.1 ft thick, and the Woodford 0.005% in intervals up to 20 ft thick. If rock of this grade ever becomes of economic interest, the small amount of overburden on the black shale of the Woodford would make it more amenable to large-scale surface-mining methods than the Chattanooga. Selected shale samples analyzed for organic-carbon content and oil yield indicated a positive relation of organic-carbon content to U content. The larger the uranium content, the higher was the sp gr of the oil. (BBB)

24120 URANIUM DISTRIBUTION IN ROCKS BY FISSION-TRACK REGISTRATION IN LEXAN PLASTIC. Kleeman, J. D.; Lovering, J. F. (Australian National Univ., Canberra). Science, 156: 512-13(Apr. 28, 1967).

When Lexan plastic is used to register fission tracks from thermal neutron-induced fission of uranium in rocks, a print of the rock texture is formed on the plastic surface after chemical etching. This print allows positive, rapid location of uranium-bearing phases in the rock and accurate determination of uranium abundances. (auth)

24121 THE URANIUM–VANADIUM ORE DEPOSIT AT THE MONUMENT NO. 1, MITTEN NO. 2 MINE, MONUMENT VALLEY, NAVAJO COUNTY, ARIZONA. Witkind, Irving J. U. S. Geol. Surv. Bull., 1107-C: 219-42(1961).

Geology of this U mining site is described. The strata range in age from Permian (De Chelly sandstone member of the Cutler formation) to Late Triassic (Shinarump member of the Chinle formation). Erosion has removed most of the Shinarump from the area, and only several small remnants remain. Two of these, each about 2000 ft long, are part of a once continuous channel fill. Three major lithologic units make up the basal channel fill: trash-pocket conglomerate, silica-cemented sandstone, and calcite-cemented sandstone. Ore minerals impregnated parts of both the trash-pocket conglomerate and the silica-cemented sandstone and formed an ore body that was collinear with the channel and that extended

for about 650 ft. The ore body ranged in width from 10 to 95 ft and in thickness from 1 to 18 ft. The core of the ore body consisted of low-valent relatively unoxidized minerals. Overlying the core were 2 incomplete concentric sheaths of oxidized minerals, the more intensely oxidized minerals being farthest from the core. The ore body was probably oxidized in place. The uraniferous material was in approximate equilibrium. The ratio of V to U for the mine was about 2.5:1. The ore was adjacent to calcite-cemented sandstone lenses; possibly the carbonate was instrumental in precipitating the ore minerals from the ore-bearing solutions. (BBB)

Seismology

Refer also to abstract 24129.

24122 COMPARISON OF CONTINENTAL SEISMIC VELOCITIES FROM EXPLOSION RESULTS AND LABORATORY MEASUREMENTS. **Asada, Toshi** (Tokyo Univ.). J. Phys. Earth, (Tokyo), 13: 1-4 (Sept. 1965).

Data on continental seismic velocities obtained from nuclear explosions in the United States are reviewed and compared with results of laboratory experiments. Information on crustal structures in various regions, mean velocities, and mean thicknesses of the layers is given in tabular form. The relation between pressure and velocities in various rocks is discussed. In the analysis presented it is proposed that the depth of the upper boundary of a layer in the crust, h, and its velocity, V, should have a relation like that obtained by high pressure measurements in rocks. The values of h and V, obtained by explosion seismological data, are compared with V and the pressure, P, obtained by experiments. It is shown that 90% of the values of V and h for the layers in which the velocities range from 5.9 to 6.3 km/sec are in the domain corresponding to granitic rocks in a V vs P diagram. (BBB)

24123 THE TRAVEL TIMES OF THE LONGITUDINAL WAVES OF THE LOGAN AND BLANCA ATOMIC EXPLOSIONS AND THEIR VELOCITIES IN THE UPPER MANTLE. **Lehmann, I.** Bull. Seismol. Soc. Amer., 52: 519-26 (July 1962).

The Logan and Blanca nuclear explosions were seismically recorded to considerable distances by many seismic stations and yielded data of great interest. The temporary stations were at distances from about 60 km to a little more than 4000 km from the Nevada Test Site. They were situated along a line extending eastward to a distance of about 2000 km and thence northeastward. At first, attempts were made to fit the time-distance points of the stations in the range 200 to 1600 km to a straight line. However, since the crust was likely to be considerably thinner under the western California stations than under the stations to the east, it seemed that the time-distance points of the different regions should be fitted onto lines of different height. Before this was attempted, comparison was made with some results obtained in other investigations for shorter distance ranges in neighboring regions. The P travel times of the Logan and Blanca atomic explosions, at the Nevada Test Site, were found to be consistent with an upper mantle structure having a discontinuity surface at about 215 km depth at which the velocity and the velocity gradient increase abruptly while the velocity varies only slightly or is constant above the depth. (BBB)

ENGINEERING

Nuclear Explosions

Refer also to abstract 24135.

24124 (AD–643573) DEVELOPMENT OF RAPID SHUTDOWN TECHNIQUES FOR CRITICAL INDUSTRIES. McFadden, Fred R.; Bigelow, Charles D. (Stanford Research Inst., Menlo Park, Calif.). Jan. 1966. Contract OCD-PS-64-201(32). 106p. CFSTI $3.00 cy, $0.65 mn.

In the event of a nuclear attack, considerable damage may result in many industries due to rapid emergency shutdown or abandonment of facilities. The process industries—including petroleum, petrochemical, and basic metals—are particularly vulnerable to shutdown damage. Sources of such damage include fires and explosions, thermal stress, and solidification of materials in vessels and pipes. Although petroleum refineries have been shut down rapidly in emergencies, such shutdowns are dangerous and may lead to extensive damage of equipment. In many refineries there is a reasonable prospect of improving the capability for rapid shutdowns through relatively modest expenditures in control equipment. Steel furnaces are particularly vulnerable to rapid shutdown. Although improvements are possible, their costs appear sizable compared with initial construction costs. (TAB)

24125 (NP–16699) ENGINEERING PROPERTIES OF NUCLEAR CRATERS. REPORT 5. RESIDUAL SHEAR STRENGTH OF WEAK SHALES. Herrmann, H. G.; Wolfskill, L. A. (Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering). Dec. 1966. Contract DA-22-079-civeng-66-3. 203p. (TR–3–699; R–66–57).

Laboratory studies of the residual shear strength of weak shales such as might be encountered in construction within the Canal Zone are described. This measurement is proposed as an index property to estimate the potential for shales or deeply weathered rocks to lose substantial strength with time. In addition to the residual strength parameter, five other index properties are outlined to form a comprehensive means for expediently evaluating potential loss of strength. The residual shear strength is a constant for any given soil regardless of stress history, and is the lowest "ultimate" strength. In practice, the laboratory measurements of residual strength can vary simply because of failure to reach this lowest strength. The main effort in this present research is to develop the equipment and testing procedures to reliably measure residual strength. It was found that the repeated direct shear test, with about 30 repetitions of loading, on mechanically disintegrated and resedimented samples resulted in an adequate index property test. The results of comprehensive testing of two Canal Zone shales (from the Cucaracha and the Culebra formations), Pierre shale from the Oahe damsite in South Dakota and a kaolinite clay are described. (auth)

24126 (SC-RR–67-3) CRATERS FROM ROW CHARGES INTERRUPTED BY A DUD. Vortman, L. J. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1967. 32p. Dep. CFSTI.

Four rows of 64-pound charges were detonated with one charge omitted to determine the effect of a dud in a row of simultaneously detonated charges, for the purpose of providing information on which to estimate the cost of remedying the consequence of a dud and, in turn, the cost justified for a further reduction of probability of a misfire. The barrier formed at the location of the dud was similar, irrespective of the position of the dud in the row. The barrier height was nearly to the original ground level and its volume averaged 40 percent greater than the crater volume excavated by a single charge in the row. Four additional shots using 1, 3, or 7 charges were fired to examine the effectiveness of barrier removal. The effectiveness increased with the number of charges used, as one or three charges left residual barriers, the height of which was respectively one-half and one-fourth the average crater depth. These results are evidence that the consequences of a dud can be repaired by additional explosions. (auth)

24127 (UCID–4867) SHOCK VELOCITY MEASUREMENTS NEAR UNDERGROUND EXPLOSIONS BY CABLE CRUSHING. Heusinkveld, M.; Holzer, F. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 4, 1963. Contract W-7405-eng-48. 32p. Dep. CFSTI.

A system has been developed for determining the instantaneous position of a stress wave near an underground explosion. In this system an electrical cable shorted at the end and serving as the inductive element in an electronic oscillator extends toward the explosion center. The advancing stress wave crushes the cable progressively, changing the cable inductance and oscillator frequency. The oscillator output is recorded as a function of time. This frequency versus time record is then converted to an uncrushed cable length, and finally to a radial range versus time relation. (auth)

24128 (UCID–15132) ACCEPTABILITY OF THE GASBUGGY SITE. Rawson, Donald E.; Korver, John A. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 12, 1967. Contract W-7405-eng-48. 126p. DTIE.

Test hole GB-1, the initial exploration hole at the proposed Gasbuggy Project site, is located in Rio Arriba County, New Mexico. No hydrologic data were collected in the section above the Ojo Alamo Sandstone. Two hydrologic tests were made in the Ojo Alamo Sandstone. The first test was made on February 23, 24, 1967 in the upper part of the sandstone in the depth interval 3,475 to 3,575 feet below the kelly bushing. The transmissibility of this zone is 0.4 gallons per day per foot, a very low value. The static water level is roughly 1,000 feet below land surface. The second test was made on February 26 and 27, 1967 in the lower part of the sandstone in the depth interval 3,575 to 3,654 feet below the kelly bushing. The transmissibility of this section was calculated to be 2.6 gallons per day per foot. The heat so far as is known is near that in the upper part of the sandstone. The transmissibility of the lower section is inferred to be somewhat higher than that in the upper part because of the greater number of fractures. The conductivity of the water in the sandstone is about 9,000 micromhos, or about 5,500 milligrams per liter of dissolved solids. In the Kirtland, Fruitland, Pictured Cliffs and upper part of the Lewis Formations, the section was drilled with gas as the circulating medium, after the hole was cased into the upper part of the Kirtland Shale. Water was not encountered in sufficient quality to prevent recovery of dry cuttings. Some core sections recovered in the lower part of the Pictured Cliffs Sandstone and upper part of the Lewis Shale were reported to be moist but the yield of water to the hole is inferred to be very small. No water was detected during drilling and testing of the Fruitland Sandstone. Therefore, this formation probably will not cause a water problem during the Gasbuggy experiment. The transmissibility of the Ojo Alamo Sandstone was found to be 0.412 gpd/ft in the upper 100 feet and 2.64 gpd/ft in the lower 70 feet. The separation between the bottom of the Ojo Alamo Sandstone (approximate elevation 3,654 feet) and the bottom of the Pictured Cliffs Sandstone (estimated elevation 4,150 feet) is about 500 feet. Should fracturing caused by the nuclear detonation reach the Ojo Alamo Sandstone, the low transmissibility of the sandstone would indicate that entry of water into the chimney would cause filling of the chimney at a rate estimated to be no greater than one foot a day. (auth)

24129 (UCRL–50182) REAPPRAISAL OF THE APPLICATION OF STATIC EQUILIBRIUM THEORY TO DECOUPLING. Knox, Joseph B.; Hearst, Joseph R. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 19, 1967. Contract W-7405-eng-48. 22p. Dep. CFSTI.

The static theory of seismic coupling of contained nuclear explosions developed by Haskell was applied to 44 nuclear explosions, and macro-scale values of the Coulomb–Mohr constant were estimated. These values for granite and salt were then used to estimate the signal-reducing effectiveness of fully decoupled cavities in these media. Granite was found to be three times more effective. The results of the calculations indicate that for cavities overdriven by a factor of 2 or more, Hardhat granite is about 60% more effective than salt in diminishing the reduced displacement potential. (auth)

24130 (UCRL–50203) EFFECT OF WATER CONTENT, YIELD, MEDIUM, AND DEPTH OF BURST ON CAVITY RADII. Higgins, G. H.; Butkovich, T. R. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 21, 1967. Contract W-7405-eng-48. 26p. Dep. CFSTI.

Cavities produced by nuclear explosions can be accurately described provided that water content, medium density, and explosive energy are known. The equation

$$R_C = 100\,\{[(\gamma - 1)W\,P_V(1/\overset{*}{\gamma}-1)] + [(\rho h)(1/\overset{*}{\gamma})]\}^{(1/3)}$$

describes results of 46 nuclear detonations in tuff, alluvium, salt and granite to the accuracy with which the cavity radius and other variables can be determined. The adiabatic expansion coefficient, $\overset{*}{\gamma}$, depends strongly on the water content of the medium. There is no indication that cavity size depends on the strength of the rock medium in which the explosion is detonated. (auth)

Facilities and Equipment

Refer also to abstracts 24124, 24127, 24186, 25060, 25062, 25100, and 25101.

24131 (SC-DR-67-219) METHOD OF APPROXIMATING CUSHION REQUIREMENTS FOR SHOCK ENVIRONMENTS. Rand, P. B. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 12p. Dep. CFSTI.

A simple method of approximating cushion material requirements for protecting sensitive equipment from damaging shock environments has been developed for materials having nonlinear stress-strain properties. A nomogram is provided as a design aid. (auth)

24132 (SC-TM-67-92) DESIGN AND PERFORMANCE CALCULATIONS OF MINIATURE dc MOTORS. I. THE ARMATURE. Himebrook, F. S. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 34p. Dep. CFSTI.

This memorandum represents one approach to the design of armatures for "miniature" DC motors. Theoretical and empirical methods are combined to reduce the "cut-and-try" activity and to minimize the overall effort required. Design of other motor parts, determinations of design constants, and performance calculations will be considered in subsequent memoranda. (auth)

24133 (TID-4100(Suppl.38)) ENGINEERING MATERIALS LIST. Supplement 38. Kelly, Robert C. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). May 1967. 76p. DTIE Free.

Forty five packages of engineering materials on laboratory equipment, instruments, metallurgical equipment, radiation detection instruments, accelerator equipment, irradiation facilities, and remote handling equipment are announced in this supplement for inclusion in TID-4100. (R.C.K.)

24134 (UCRL-50194) SURVEY OF THERMAL EFFECTS IN MANUFACTURING. Bryan, J. B.; McClure, E. R. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 6, 1967. Contract W-7405-eng-48. 52p. Dep. CFSTI.

A survey of a variety of manufacturing facilities, with emphasis on those producing machine tools, has shown that thermal effects are considered a serious handicap to the achievement of precision. Methods of combating the thermal problem are varied and often are based on inadequate information. At present, achievement of precision is possible through time-consuming and costly processes mostly based on the adaptivity of human operators. With increased use of numerically controlled machine tools, the thermal effects problem will necessarily receive greater attention. (auth)

24135 (UCRL-50195) DEVELOPMENT OF AN AIRBORNE EHF RADAR SYSTEM FOR CLOUD DETECTION. Colmar, P. V.; Williams, R. T. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 1967. Contract W-7405-eng-48. 32p. Dep. CFSTI.

The LAPQ-1 airborne radar system was developed to detect and delineate nuclear clouds so that an aircraft could be directed into the proper position to launch ballistic sampling rockets into the clouds. The radar beam has a width of less than one degree, a wave length of less than one centimeter, and a frequency of 35 giga-Hertz. The average power is only 40 W, while the peak power is 100 kw delivered in 400 one-microsecond pulses per second. The system provides both vertical and horizontal views through target clouds, and can scan 180 degrees horizontally or 60 degrees vertically at a rate of six times a minute. Ice clouds similar to nuclear clouds were detected at ranges up to 198 nautical miles, and the rear edges of clouds up to 50 miles across were delineated. Cloud targets were acquired at a range of 25 miles after penetration of 10 miles of heavy rainfall. Operation in this extremely high-frequency (Ka) band makes the system most suitable for studies of cloud physics phenomena, or for other applications in which superior resolution, small antenna apertures, and reduced weight are important considerations. Signal attenuation was substantially less than expected, particularly in heavy rainfall at low altitudes, which suggests that existing attenuation data for the Ka band should be re-examined. (auth)

24136 (UCRL-50211) NECESSARY CONDITIONS FOR SIMILAR SOLUTIONS OF PROBLEMS OF TURBULENT-GAS DYNAMICS. Crowley, Barbara K. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 31, 1967. Contract W-7405-eng-48. 29p. Dep. CFSTI.

The quasi-one-dimensional conservation equations with friction, heat, and mass sources are considered. Necessary conditions for similar solutions of these equations are mathematically derived, and these conditions are verified by sample computer calculations. (auth)

24137 (UUIP-517) A SPECIAL GLOVE BOX FOR PREPARATION OF Th-B SOURCES. Bergman, Curt (Uppsala Univ., (Sweden). Inst. of Physics). Jan. 1967. 10p. Dep. mn.

A glove box, constructed with special consideration for protection from gaseous daughter activities of ^{228}Th and from gamma radiation, is described. It is shown that the accelerating voltage should not be higher than 500 V and that the source geometry has an important effect on the source strength and the shape of the thorium A-line. (auth)

24138 (Y-1567) AN AUTOMATIC LINEAR VARIABLE DIFFERENTIAL TRANSFORMER (LVDT) CALIBRATOR. Cromwell, H. H.; Lee, W. W. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Apr. 26, 1967. Contract W-7405-eng-26. 82p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A system for automatically calibrating a linear variable differential transformer (LVDT) employs a small digital computer and an optical interferometer. The interferometer is used to measure displacements. Interfacing circuits enable the computer to control external equipment and track armature displacement. The computer contains an analog-to-digital converter which reads the LVDT output voltage while the armature is moving. Appropriate software performs mathematical operations on the data and types the results on a teletype. Calibration time is reduced from approximately two hours to approximately two minutes. Tests indicate that total uncertainty in the output is ±0.08 percent at the 95 percent confidence level. (auth)

24139 (ORNL-tr-1609) INVESTIGATION OF THE POSSIBILITY OF MONITORING IMPURITIES IN LIQUID-METAL COOLANTS BY MEASUREMENT OF THE ELECTRICAL RESISTANCE. Arnol'dov, M. N.; Ivanovskii, M. N.; Subbotin, V. I.; Shmatko, B. A. Translated for Oak Ridge National Lab., Tenn., from a paper presented at the IAEA Symposium on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna, November 29-December 2, 1966. 11p. (CONF-661110-11). Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Data are given for the electrical resistivity of Li at 300°C as a function of N, O, and H dissolved in the Li, and of Na at 350°C as a function of H dissolved in the Na. It was found that for Li and Na, the electrical resistance depends on the H content but is independent of the O content. Electrical resistivity of Li also depends on N dissolved in the Li. Monitoring of H in Na and H and N in Li is not selective in relation to the impurity. In monitoring Na for H, the content of H can change due to temperature, pressure, or gas flow over the surface of the liquid metal. (F.S.)

24140 DECONTAMINATION OF A PWR. Ayres, J. A.; Perrigo, L. D.; Weed, R. D. (Battelle-Northwest, Richland, Wash.). Nucleonics, 25: No. 4, 58-63; 72(Apr. 1967).

A successful method for chemically decontaminating a pressurized water reactor using alkaline permanganate followed by a citrate-oxalate solution is described. The decontamination gave high decontamination factors, low uniform corrosion rates of the major construction materials, and no evidence of nonuniform corrosion. (F.S.)

24141 MANAGING YOUR NUCLEAR FUEL. PART 2. URANIUM ORE: PURCHASING ON THE LONG TERM. Warren, F. H.; Steyn, J. J. (NUS Corp., Washington, D. C.). Nucleonics, 25: No. 4, 31-5; 39; 42(Apr. 1967).

In order to make the expected operating profit over the lifetime of a nuclear electric plant, the utility company must be able to obtain a fuel supply for the life of the plant. Studies made on U ore long term purchase show: larger ore reserves are needed, new discoveries should carry the industry until 1980 provided new mills are in operation by 1973, ore prices will not be related to value until a buying pattern develops and an open market exists, and prices will be high in the early 1970's. On a world-wide basis studies indicate that future U_3O_8 prices may follow the extremely stable pattern exhibited over long periods by other low-grade metal such as lead or zinc. (F.S.)

24142 CAPACITY AND EFFICIENCY OF DIFFERENT RADIATION SOURCES FOR THE IRRADIATION OF FOOD. Gruenewald, Th; Tuchscheerer, Th. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Atompraxis, 13: 107-12(Mar. 1967). (In German).

Different radiation sources, such as particle accelerators and radioisotopes, are compared as to their possible use for food irradiation. Formulas for the calculation of the needed beam power, the demanded capacity, and the efficiency of planned facilities are presented. Operation of pilot plants by these criteria is described. (auth)

24143 WORLD URANIUM SUPPLY AND DEMAND FACTORS AS APPLIED TO AN ECONOMETRIC MODEL WITH SPECIAL REFERENCE TO STOCKPILING. Ball, G. R. (Denison Mines Ltd., Toronto). Neue Tech., 9: 53-6(Apr. 1967).

An IBM 7044 computer program was developed to describe the world's U supply and demand based on an econometric model. Three different types of output are available for 16 demand burn-up configurations. One output describes stockpiles for each country

and includes total stockpile, sales from the stockpile in pounds per average price, sales at a loss including price received, and world price at the end of the year. Another type of output indicates contract information including contract amount, country of origin, annual amounts, term of contract, amount of contract for each mine, and price. The third output provides information on mine conditions per year, code number of the mine, location, annual production, total reserves, mine stockpile, sales in pounds, price received, and subsidy, if any. The program was written in an effort to stabilize the price of U and to avoid erratic U pricing which could have adverse effects on the nuclear industry. (F.S.)

24144 AEI'S 660MW TURBINE-GENERATORS. AEI (Ass. Elec. Ind.) Eng., 7: 16-19(1967).

Different but Similar Articles on This Subject Are Also Found in Engineer, 223: 579-80(Apr. 21, 1967); Engineering, 203: (Apr. 21, 1967); Elec. Rev., 180: 586-8(Apr. 21, 1967); and Elec. Times, 151: 630-2(Apr. 20, 1967).

The design of the turbine-generators for Hinkley Point "B" Power Station is described. The principle of unit construction, which is applied to the whole machine, takes full advantage of the use of steel foundations. The turbines are designed as subcritical single reheat units for inlet steam conditions of 2,300 psi and 538°C. (UKAE)

24145 LARGE VOLUME DEGAUSSER WITH GRADIENT COMPENSATION. Freedman, Melvin S.; Wagner, F. Jr.; Porter, F. T.; Day, Paul (Argonne National Lab., Ill.). J. Appl. Phys., 38: 1856-62(Mar. 15, 1967).

A solution is presented to the practical problem of adapting known theoretical multicoil magnetic field generators for compensation of slightly inhomogeneous fields. Three concentric orthogonal sets of coils are used as uniform field generators. The two sets used to compensate the strong field components are each an array of four parallel, equal-size square coils, separated by $\frac{1}{3}$ of a side length, i.e., uniformly spaced on the surface of a cube. Each of these sets generates a magnetic field uniform of 2×10^{-4} within the central sphere of diameter equal to 0.2 of the side length of a coil. The outer pair of coils (22 turns each) and the inner pair (13 turns each) are series connected to a single current supply. By shunting small fractions of the current from one-half of two of the three coil sets, and by appropriate location of two pairs of small coils near the main degausser coils (also series connected), field gradients that result in variations of the order of 2×10^{-3} of the uncompensated field over the central sphere can be compensated. Construction and performance specifications are given. (auth)

24146 SOLUTION OF THE EQUATIONS OF A REGULAR BEAM EMITTED FROM A CURVILINEAR SURFACE IN THE NONSTATIONARY CASE. Syrovoi, V. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 48-57(Nov.-Dec. 1966). (In Russian).

An analytic solution is presented of the equations of a regular monoenergetic nonrelativistic beam of charged particles, having the same value and sign of specific charge, emitted from an arbitrary surface in the nonstationary case, for the case of space-charge limited emission with and without nonzero electric field on the emitter. A special coordinate system is used, in which the emitter is one of the coordinate surfaces. The current density, the electric field on the emitter, and the magnetic field are specified functions of the coordinates. The solutions are presented in the form of series in powers of the coordinates, with coefficients that depend on the time and on the remaining coordinates and are determined from recurrence relations. The results are applied to calculate emission from a planar, cylindrical, and spherical diode for the case when the high-frequency component of the current density is not small compared with the dc component. (ATD)

24147 PRODUCTION OF EXTREMELY WEAK BREMSSTRAHLUNG WITH VOLTAGES FROM 50 TO 5000 V FOR BIOPHYSICAL X-RAY MICROGRAPHY. Rajewsky, B. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Z. Naturforsch., 21a: 1801-8(1966). (In German).

The tasks of biophysical x-ray micrography and its characteristics were explained. The necessity of expanding the wavelength region of the x-rays from the extremely soft region up to a quantum energy of approximately 13 eV was shown. The studies and development projects at the Max Planck Institut for Biophysik in Frankfurt am Main were reported. The newly constructed x-ray tube permits a continuous operation at 50 V and 10 mA. A further reduction of the tube voltage at still smaller current intensity is probably possible. Some examples of the x-ray micrographs of biological structures obtained with these types of x-ray tubes were given and briefly explained. (tr-auth)

24148 MULTISTAGE FLASH EVAPORATORS TODAY. McArthur, N. Petrol. Times, 71: 226-7(Feb. 3, 1967).

An evaluation of the present state of flash evaporation, based on experience with operating plants, is made under the following: introduction, basic principles, brine recirculation, scale control, and operating parameters. (UK)

24149 IMPROVEMENTS IN AND RELATING TO STEAM GENERATORS. Heathcote, John; Jones, Francis Robert (to Foster Wheeler Ltd.). British Patent 1,066,972. Apr. 26, 1967. Filed June 19, 1963.

A tubular steam generator is described in which the heating fluid is a liquid metal such as sodium. The invention comprises a vertical cylindrical pressure vessel containing an open-topped vessel which contains the liquid metal and a tube system which consists of clusters of straight tubes. Each cluster may be withdrawn from a vertical duct in the open-topped vessel. Therefore, a tube failure can not cause a destructive reaction between the water and Na. (F.S.)

24150 APPARATUS FOR THE RADIOACTIVE DECONTAMINATION OF WATER. Bovard, Pierre; Grauby, Andre (to CEA). British Patent 1,066,374. Apr. 26, 1967. Priority date June 21, 1963, France.

A method is described for decontaminating water contaminated by radioactive elements. In the method described, an inert filter and an electric filter are used. The inert filter consists of a column closed at one end and containing a porous medium with good exchange capacity. This medium may be talc, kaolin, bentonite, vermiculite, diatomics, resins, or activated carbon. The electric filter consists of an electrolytic tank and non-toxic electrodes. (F.S.)

24151 TUBULAR EXTRUSION DRYER. Sprissler, B.; Pease, E. P. (to U. S. Atomic Energy Commission). U. S. Patent 3,319,351. May 16, 1967.

A system is described for drying nuclear fuel particles that are extruded at low temperatures. An annular array of interfitting tubes is used for receiving and rotating the extrusions around an axis so as to roll the extrusions within the tubes while the extrusions are heated and air is blown around, over and through the extrusions. (AEC)

24152 IMPROVEMENTS IN OR RELATING TO RADIOACTIVE-SOURCE IONIZATION PRESSURE GAGES. Boiziau, Claude (to CEA). British Patent 1,066,687. Apr. 26, 1967. Priority date Aug. 6, 1964, France.

A radioactive ionization-pressure gage for measuring pressures from 0.75×10^3 to 0.75×10^{-4} mm Hg is described. The gage consists of an enclosure, an ionization chamber, a Pu source, and associated electronic equipment. The gas, the pressure of which is to be measured, is admitted to the enclosure. Alpha particles emitted by the source ionize the gas. An ionization chamber measures the number of ionized particles which are directly proportional to the gas pressure. (F.S.)

24153 TIME-FORCE INTEGRATOR (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE-1570).

39 drawings.

The Time-Force Integrator ($\omega^2 t$) is used with liquid centrifuges in biological research to provide a numerical value related to the total centrifugal force applied to the centrifuged material. It is, in effect, a small, special purpose, solid state, hybrid computer which computes the value of the square of the rotor angular velocity integrated over the time of the centrifugation run. The system consists of a speed detector and driver amplifier mounted on the centrifuge and relay rack mounting chassis containing all the remaining components. A means for checking the calibration at two different count rates is built into the system. (For details see TID-4100 Suppl. 40) (auth)

24154 CONTROLLED POTENTIAL COULOMETER (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1571).

66 drawings.

The controlled potential coulometer consists of two plug-in modules, the potentiostat and the integrator, each of which may also be used independently. The potentiostat is based on solid state operational amplifiers and a special power booster. The instrument has an output of ±24 V at ±400 mA without current polarity switching, and incorporates a convenient means for gain bandwidth switching so that response may be tailored to a variety of systems. The integrator utilizes a high-voltage, transistorized operational amplifier and high stability passive components. Included in the readout circuit is a compact, 4 decade voltage divider, designed for use with a digital voltmeter. (For details see TID-4100 Suppl. 40) (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 24149, 24708, 24819, 25058, 25059, and 25640.

24155 (GEAP-5426) TRANSITION BOILING HEAT TRANSFER PROGRAM. Sixteenth Quarterly Progress Report, October-December 1966. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 3, 1967. Contract AT(04-3)-189. 29p. (EURAEC-1792). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The series tests with the tube test section were performed at 1000 psia with mass velocities of 0.5 and 0.75 million lb/h-ft^2. Fully-developed film boiling coefficients were measured, along with steam phase temperatures, using a special temperature probe. The probe data demonstrated quantitatively that the steam phase was superheated for heat transfer from a dry wall to a flowing steam-water mixture. A new single-rod annular test section has been designed for obtaining fully-developed heat transfer coefficients and bulk steam phase temperature measurements. The design incorporates small profile spacers, 18-inch spans between spacers, and special construction for attaining higher heated wall temperatures than previously possible. (auth)

24156 (GEAP-5441) TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES. Quarterly Progress Report No. 9, October 26, 1966-January 25, 1967. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar. 1967. Contract AT(04-3)-189. 37p. Dep. CFSTI.

Results of isokinetic probe measurements of the nine-rod steam-water tests are described. Single-phase sample flow was measured for various values of pressure difference between probe and channel. The calculated sample flow rate, assuming a loss at probe inlet equal to 75% of the calculated laminar flow inlet loss, is in good agreement with the measured rate. Two-phase sample flow rate and enthalpy were measured. A model was devised to assist in interpreting the measured results. Attention was focused on flow in Subchannel No. 1, bounded by the corner rod and the channel corner. Average quality was determined for Subchannel No. 1, using the isokinetic data plus nine-rod air-water data. At average channel qualities of 15% the quality in Subchannel No. 1 under adiabatic conditions is much lower than the channel average; under boiling conditions, it is close to the channel average. The COBRA code was used to supply calculated values of the exit conditions in the subchannels of the Task B nine-rod test section. Two internally heated annulus correlations were used to predict the critical heat flux, based on conditions in the corner subchannel (Subchannel No. 1). Predicted and measured values are compared. This appears to be a promising procedure for predicting critical heat flux in a multirod array. (auth)

24157 (MND-3607-92(App.)) SNAP 19 GENERATOR HEAT DISTRIBUTION TEST: MACH 8. (Martin Co., Baltimore, Md.). Feb. 1967. Contract AT(30-1)-3607. 141p. DTIE.

An appendix to Report MND-3607-92 on the SNAP-19 generator is presented. Printouts of data from the SNAP-19 Generator Heat Distribution Test at Mach 8 are presented. (L.C.L.)

24158 (MND-3607-92(Vol.1)) SNAP 19 GENERATOR HEAT DISTRIBUTION TEST AT MACH 8. Adams, R. C.; Fluet, C. A. (Martin Co., Baltimore, Md.). Mar. 1967. Contract AT(30-1)-3607. 178p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Heating data were obtained for three 30% scale models of the SNAP-19 generator. The three models having different fin spans (full, two-third and one-third span) were tested at the Von Karman Facility, AEDC Tunnel B Mach 8 with fixed pressure and temperature. The one-third span model was also tested to determine the effects of increased Reynolds number. The models were tested at roll angles of 0 and 30 degrees over the angle of attack (α) range of 0 to 90 degrees. Data obtained during the test were processed and presented for all thermocouples of each configuration and average heating rates for each thermocouple over a 90-degree angle of attack range. The data presented are sufficiently comprehensive and accurate to be used in a burnup analysis of the SNAP-19 generator during reentry. The precision of the data was demonstrated by repeat runs to be within the reported accuracy. The results indicate that the average heating rates decreased on both the generator body and fins as the fin span decreased, i.e., during simulated fin disintegration. It was also observed that increasing the Reynolds number tends to increase the average heating rate on both the generator body and the fins. (auth)

24159 (RT-ING-(66)-20) THERMODYNAMICS OF TWO-PHASE DIABATIC FLOW AND RELATED INSTABILITIES. Basso, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1966. 31p. Dep.

The analysis is limited to flow with an intense heat addition in which the kinetic energy of the fluid degraded to heat, owing to internal friction, can be neglected when compared with heat input. It is concluded that burnout related to hydrodynamic instability can occur only during transition to annular flow when the liquid film becomes fairly independent of the central foggy core. (J.R.D.)

24160 (SC-TM-66-2632) HEAT PIPE. Feldman, K. Thomas Jr.; Whiting, Glen H. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT(29-1)-789. 14p. Dep. CFSTI.

The heat pipe is a unique and simple heat transfer device which has an effective thermal conductivity several hundred times that of copper. The operating principles and characteristics of the heat pipe are described. Performance characteristics, possible applications, and current research and development activities are discussed. (auth)

24161 (WAPD-Trans-51) STABILITY OF A BAR IN PARALLEL FLUID FLOW WITH FRONT DRAG TAKEN INTO CONSIDERATION. Kordas, Zdzislawa. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Rozpr. Inz., 13: 19-41(1965). 43p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $4.60 fs, $1.49 mf.

The stability of a bar (plate) which is clamped at one end and subjected to hydrodynamic forces was studied. The magnitude of the hydrodynamic forces was determined using the simplest streamline theory. The stability of a combined load was analyzed since a literature survey produced information only on frontal or lateral loads. Equations were developed for small lateral vibrations of the bar and for the limit curve for an assumed form of the deflection. The equations were examined using as coordinates dimensionless flow velocity and dimensionless front drag. (F.S.)

24162 STUDY ON THE MEASUREMENT OF VOID FRACTION BY PROBE METHOD. Iida, Yoshihiro; Kobayasi, Kiyosi (Tohoku Univ., Sendai). Nippon Genshiryoku Gakkaishi, 9: 2-7 (Jan. 1967). (In Japanese).

Void fraction is one of the most important factors in the study of two-phase flow. There are many methods for measuring this value, but few provide accurate results for the local void fraction. An attempt was made to find a method for accurately determining the local void fraction. The detector was composed of a probe and a plate electrode, which detects the difference in electrical conductivity between the liquid and gas phases between two electrodes. Void fraction can be expressed by the ratio between the time during which the probe is occupied by the gas phase and the total measuring time. Actually, the void fraction is found by using a signal generator and an electronic counter. Experiments were made to study the influence of the probe on the flowing bubbles. The measured values by this method agreed well with the values from other methods. Finally, this method was applied to measure the distribution of void fraction along a cross section of a channel. (NSA of Japan)

24163 LIQUID-METAL HEAT TRANSFER IN A PARALLEL-PLATE CHANNEL WITH PERIODIC BOUNDARY CONDITIONS. Hsu, Chia-Jung (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 28: 301-5(May 1967).

The problem of heat transfer to fluids flowing inside channels with wall temperature or wall heat flux varying in a periodic manner was investigated. Such a problem may occur, for instance, in the cooling of thermionic fuel elements by liquid metals in a nuclear thermionic space power plant. Equations are derived for a more general case of fluid flow with uniform heat generation. It was concluded that the behavior of Nusselt number for channel flow with periodic variation of boundary conditions differs appreciably from that for the case without the periodic change. The difference is particularly pronounced in the thermal-entry region. (R.C.K.)

24164 FRICTION FACTOR MEASUREMENTS IN A RECTANGULAR CHANNEL WITH WALLS OF IDENTICAL AND NON-IDENTICAL ROUGHNESS. Wilkie, D.; Cowin, M.; Burnett, P.; Burgoyne, T. (United Kingdom Atomic Energy Authority, Cumberland, Eng.). Int. J. Heat Mass Transfer, 10: 611-21 (May 1967).

Friction factor measurements were made in a rectangular channel formed essentially by two flat plates roughened by transverse isolated square ribs. When the plates are not identically roughened theory allows the friction factor of each surface to be separated and applied to other passages having ribs with the same ratios of pitch to height and height to equivalent diameter. The experiments indicate that the application of this theory produces friction factors which, compared with those for identically roughened plates for which no transformation is required, vary similarly with Reynolds number but differ in magnitude, but by less than 10 percent over the range covered. The results show only moderate agreement with similar results obtained from an annular channel. (auth)

Isotope Technology

Refer also to abstracts 24142, 24157, 24158, 24182, 24708, and 25545.

24165 (HIT-3627-15(Del.)) ADVANCED LARGE MILLIWATT RADIOISOTOPE GENERATOR STUDY PROGRAM. Final Report. (Hittman Associates, Inc., Baltimore, Md.). May 31, 1966. Contract AT(30-1)-3627. 251p. (HIT-218(Del.)). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A summary of the parametric and design study effort conducted on the Advanced Large Milliwatt Radioisotope Generator Study Program is presented. The purpose of the program was to conduct a parametric study to determine the general characteristics of various advanced large milliwatt thermoelectric generator systems within the state-of-the-art and to conduct design studies resulting in preliminary specifications for certain systems selected on the basis of a requirement survey. A complete program summary and the technical characteristics of the systems studied are described. (R.C.K.)

24166 (IN-1081) RAPID SOURCE PREPARATION TECHNIQUE FOR HIGH-RESOLUTION ALPHA PARTICLE SPECTROSCOPY. Deal, R. A.; Chanda, R. N. (Idaho Nuclear Corp., Idaho Falls). Apr. 1967. Contract AT(10-1)-1230. 12p. Dep. CFSTI.

A rapid method was developed for the preparation of sources for high-resolution alpha particle spectroscopy. The method involves the extraction of a nuclide into an organic phase. An aliquot of the organic is then transferred to a counting plate, evaporated to dryness, and finally ignited leaving a mass-free plate. Sources prepared in this manner are of a quality equal to other methods currently in use. (auth)

24167 (ISS-66/46) INDUCED ACTIVITY OF INDIUM AND CADMIUM THROUGH ^{60}Co PHOTON IRRADIATION. Cortellessa, G.; Grisanti, A.; Tori, P. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Nov. 21, 1966. 16p. Dep. mn.

Activation of natural indium and cadmium by means of irradiation with ^{60}Co photons is discussed. Preliminary experimental results are presented, together with a brief discussion of dosimetric applications and possible health physics implications. (auth)

24168 (MMM-3418-05) SNAP 23 PROGRAM: TERRESTRIAL RADIOISOTOPE FUELED THERMOELECTRIC POWER SUPPLY SYSTEM. Quarterly Report No. 1, June 15, 1964–October 31, 1964. Murphy, J. C. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). Nov. 1964. Contract AT(30-1)-3418. 132p. Dep. CFSTI.

Progress is reported on the design and development of a ^{90}Sr isotope-fueled, thermoelectric generator for terrestrial applications. The thermoelectric generator will produce 60 watts at 24 volts, direct current. A dc–dc converter will not be used; however, a shunt type voltage regulator will be provided. The objective is to produce a system which will permit the most efficient utilization of radioactive ^{90}Sr fuel while secondarily limiting size and weight to a minimum. The power supply system consists of three major components, which are as follows: thermoelectric generator, insulation envelope, and heat source. These components can be assembled to form the power system without the use of hot cell facilities. The thermoelectric generator consists of the thermoelectric conversion hardware and the cooling fins. The heat source consists of two doubly encapsulated fuel capsules surrounded by a biological shield of a depleted uranium alloy. To minimize heat losses, the heat source is placed in an insulation envelope. The system design provides two major advantages which are: field installation or service can be accomplished without hot cell facilities and development time is minimized by parallel development of each subsystem. (auth)

24169 (MMM-3418-08) SNAP-23: TERRESTRIAL RADIOISOTOPE FUELED THERMOELECTRIC POWER SUPPLY SYSTEM. Quarterly Report No. 2, November 1, 1964–January 31, 1965. Murphy, J. C. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). Feb. 1965. Contract AT(30-1)-3418. 96p. Dep. CFSTI.

Progress is reported on the design and development of a ^{90}Sr isotope-fueled thermoelectric generator for terrestrial applications. A new feature was incorporated into the current design which would permit shipment of the power supply system as an assembled unit. The thermoelectric couple design was changed to obtain a more accurate theoretical heat balance of the legs and a more conservative estimate of the internal electrical losses within the generator. This change affected the following: the number of thermoelectric couples required for the generator, the length of the P-type and N-type legs, and the thermoelectric materials selected for the couple design. (auth)

24170 (MMM-3418-17) SNAP-23: TERRESTRIAL RADIOISOTOPE FUELED THERMOELECTRIC POWER SUPPLY SYSTEM. Quarterly Report No. 3, February 1, 1965–April 30, 1965. Murphy, J. C. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). May 1965. Contract AT(30-1)-3418. 79p. Dep. CFSTI.

The design and development of a 90-Sr isotope-fueled thermoelectric generator for terrestrial applications is described. The system is designed to withstand the following shock loading in the assembled configuration: vertical axis: 10 g half-sine and radial axis: 5 g half-sine. Thermoelectric couple testing in six-couple modules continued. The current thermoelectric couple design is producing the designed power while operating in six-couple test modules. (auth)

24171 (MMM-3418-22) SNAP-23: TERRESTRIAL RADIOISOTOPE FUELED THERMOELECTRIC POWER SUPPLY SYSTEM. Quarterly Report No. 4, May 1, 1965–July 31, 1965. Murphy, J. C. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). Aug. 1965. Contract AT(30-1)-3418. 90p. Dep. CFSTI.

The assembly of the first SNAP-23 system generator component (3M-39-P1) has been completed. The excellent performance demonstrated during initial testing of this generator indicates that a significant milestone has been reached in the design and operation of thermoelectric conversion devices. This achievement is significant in that actual performance has met earlier predictions. (auth)

24172 (TID-23666) EXPLORATORY DEVELOPMENT OF THE RADIOTRACER PROPELLANT GAUGE. Final Report, Phase II. Burns, B.; Harman, R. W.; Rusch, R. J.; Spencer, R. B.; Sisk, G. A. (TRW Systems, Redondo Beach, Calif.). Nov. 1966. Contract AT(04-3)-539. 146p. Dep. CFSTI.

The analytical and experimental evaluation of radiotracer propellant gauge components is described. Progress is reported on the following major efforts: (1) A radiotracer propellant gauge for a bladder expulsion system was fabricated and successfully tested. Gauge components were designed to meet typical system requirements since the specific gauge design depends strongly upon mission and spacecraft requirements. (2) Analyses and tests were performed to evaluate ^{85}Kr interactions with bladder expulsion system propellants and materials. Analyses were performed to assess the effect of these interactions on gauging performance. Experimental evaluations of ^{85}Kr diffusion through bladder materials and of ^{85}Kr solubility in liquid rocket propellants were accomplished in this task. (3) Several techniques were investigated for the application of radiotracer gauging techniques to bladderless expulsion systems. The techniques studied were the tagging of the pressurant gas with a radiotracer for storable propellant systems and the use of the helium scintillation phenomenon for gauging cryogenic propellants. (4) Krypton injector assemblies were designed and fabricated. Experimental evaluation of the injectors demonstrated the practicability of loading, sealing, and storing precise, reproducible quantities of ^{85}Kr gas mixtures under high pressures. (5) Flight-type detector electronics packages were designed, procured, and tested. It was concluded that integrated circuit electronics of the type tested would be satisfactory for the gauging system provided a well regulated power supply was used, and (6) Methods were investigated for protecting exposed gauge detectors from highly corrosive propellant vapors while still permitting transmission of beta radiation. (auth)

24173 MISCIBLE DISPLACEMENT THROUGH GAMMA RADIATION: STERILIZED SOIL COLUMNS. Corey, J. C.; Nielson, D. R.; Picken, J. C. Jr.; Kirkham, Don (Iowa State Univ., Ames). Environ. Sci. Technol., 1: 144-7(Feb. 1967).

Gamma radiation from a ^{60}Co source has proved successful in sterilizing soil columns. Sterile miscible displacement methods were used to follow the displacement of nitrate at slow velocities through soils. After a soil column was sterilized, 100% of the nitrate added to a Webster soil-sand column was recovered in the effluent after displacement at 0.055 cm. per hour, while 66% of the nitrate was recovered when displaced through a nonsterile column at the same velocity. (auth)

24174 CHARGE TRANSFER IN THE JOSHI EFFECT UNDER MONOCHROMATIC X AND γ RAYS IN AN OZONIZER DISCHARGE. Arnikar, H. J.; Kanitkar, P. L.; Mande, C. (Univ. of Poona). Brit. J. Appl. Phys., 18: 243-5(Feb. 1967).

The Joshi effect (an almost instantaneous and reversible change in a discharge current due to external irradiation) was studied in terms of the overall charge conveyed by the pulses produced in an ozonizer discharge through hydrogen due to dc excitation in the dark and under irradiation by x and γ rays. It was observed that the charge transferred per minute was reduced under irradiation. This reduction was found to be independent of the applied potential over the range studied (750 to 1200 V). (auth)

24175 EVAPORATION LOSSES DURING RADIOISOTOPE STANDARDIZATION PROCEDURES. Goodier, I. W.; Pritchard, D. H. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop., 18: 332-4(May 1967).

In the preparation of radioactivity standards, techniques are often used which could introduce errors associated with solution evaporation. In view of this a study was made of the effects of evaporation during manipulative procedures involved in standardization, using ^{59}Fe Cl_3 in HCl and in HCl/methanol, the latter having a much higher evaporation rate. Measurements were made using a high pressure 4π ionization chamber and the 4π β-γ concidence technique. Percentage differences on comparing the standardizations using the normal HCl carrier and the more volatile mixture of methanol and HCl were 0.2%. For the manipulation techniques employed, the error due to evaporation loss was equivalent to about 0.03%, allowing for the differences in evaporation rates (factor of 6) of the two solutions. The small magnitude of this loss suggests that errors due to evaporation are relatively unimportant for carefully chosen techniques. (UK)

24176 BALANCED QUENCHING METHOD FOR COUNTING ^{14}C. Ross, H. H. (Oak Ridge National Lab., Tenn.). Int. J. Appl. Radiat. Isotop., 18: 335-6(May 1967). (ORNL-P-2399).

The balanced quenching method for counting ^{14}C was first proposed in Int. J. Appl. Radiat. Isotop. 15: 273(1964). Some comments on the method were made in the same journal (17:193 (1966)). A reply to these is presented. (UK)

24177 RADIOGRAPHIC METHOD FOR INVESTIGATION OF THE MOVEMENT OF SAND AND SEDIMENT IN RIVERS USING ^{32}P. Hazzaa, I. B. (Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo). Int. J. Appl. Radiat. Isotop., 18: 273-8(May 1967).

Experiments were carried out to select the best radioisotope to label sand and sediments of the Nile and the Mediterranean. The radioisotopes tried were ^{32}P, ^{51}Cr, ^{110}Ag, ^{131}I and ^{140}Ba. Radioactive phosphorus was found to be one of the best nuclides for labelling. As a pure β-emitter, its detection was efficient when performed by radiographic methods. The radiographs obtained in two experiments undertaken in one of the Nile branches in Cairo proved that the method could be applied to indicate the direction of movement of sand and sediment in rivers and seas. (UK)

24178 SURVEY OF THERMO-RADIOISOTOPE PROPULSION AND INTEGRATED POWER SYSTEMS FOR SPACECRAFT. Romero, Jacob B.; Reichel, Rudolf H. (Boeing Co., Seattle). Raumfahrtforschung, 11: 61-71(Apr.-June 1967).

Various aspects associated with the application of radioisotopes to spacecraft propulsion and integrated power are reviewed, and the status of appropriate programs is assessed. Potential radioisotope heat sources are compared on the basis of availability, cost, radiation characteristics, chemico-physico properties, half-life, and performance. Out of the potential candidates, Po-210 appears to be the preferred choice for short-term applications, and Cm-244 for long-term applications. Thruster design concepts under consideration include solid-cores with a specific impulse capability of up to 800 lbf-sec/lb, molten-cores with a capability of up to 1,200 lbf-sec/lb, and integrated propulsion/power units which can supply both propulsion and supplementary power to a spacecraft. Analytical studies include application of radioisotopes to both manned and unmanned missions. Application of radioisotope thrusters for reaction control in some earth-orbital missions results in propellant mass savings of 40 to 50%. Radioisotope thrusters also show exceptional capabilities for planetary flyby and orbiter missions when based on present booster concepts. (auth)

24179 RADIATSIONNAYA AVTOMATIKA I KONTROL' V GORNOM DELA. (Radiation Automatics and Control in Mining). Segalin, V. G. Moscow, Izdatel'stvo Nedra, 1966. 398p.

General and particular questions on the use of radioisotopes for the automation and technological control in mining were examined. The future use of radioisotopes in mining was discussed and their classification given. The characteristics of radioisotopes and methods for their use were discussed. (tr-auth)

24180 EFFICIENT BETA-RAY EMISSION SOURCE FOR IRRADIATION APPLICATIONS. Yavorsky, P. M. (to U. S. Atomic Energy Commission). U. S. Patent 3,322,951. May 30, 1967.

An efficient beta-ray emission source for irradiation application is described. The source consists of a core compound of tightly compacted particulate strontium-90 titanate intimately encapsulated within a thin stainless steel sheath. (AEC)

Materials Testing

Refer also to abstracts 24254, 24259, and 25625.

24181 (SC-DC-67-1630) SHOCK SIMULATION. Brooks, R. O. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 21p. (CONF-670412-1). Dep. CFSTI.

From Institute of Environmental Sciences Meeting, Winter Park, Fla.

Test Equipment was devised to simulate impact shock conditions and to subject small component test specimens to controlled, reproducible shocks. Instrumentation for measuring the effects of shock are described. (L.C.L.)

24182 APPLICATIONS OF BACKSCATTERED RADIATION. Nydegger, R. R. (Univ. of Kansas, Lawrence). Progr. Appl. Mater. Res., 7: 135-59(1967).

Applications of backscattered radiation are reviewed under: interaction of radiation with materials, radiation detection, analysis of radiation backscatter, and current work with backscattered radiation. With regard to current work, backscattered radiation is being used in industrial thickness gauging. Experimental studies indicate the possibility of its use to determine the integrity of welds and to detect micro-defects in materials. It is probable that ion scattering may be used to study the composition or surface features of materials. One disadvantage is that only a small percentage of incident radiation is scattered back through any given scattering angle, and this is particularly so for high energy penetrating radiation. For high resolution inspection this can only be compensated by increasing the intensity of the source of increasing the observation time. Additional experimental work is needed to determine optimum types and energies of radiation, to improve detector resolution and shielding, and to simplify read-out methods. (UK)

Radioactive Material Handling

Refer also to abstract 24118.

24183 (BNWL-SA-983) CRITICALITY OF PLUTONIUM COMPOUNDS IN THE UNDERMODERATED RANGE, H/Pu ≤ 20. Hansen, L. E.; Clayton, E. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 27, 1966. Contract AT(45-1)-1830. 21p. DTIE.

Nuclear criticality control involves the application of criticality data to those operations involving fissile materials. A variety of plutonium compounds are known to exist for which experimental criticality data are particularly lacking. In order to obtain data for nuclear safety guidance, a series of calculations were made to determine the bare and water reflected spherical critical masses for 12 of these compounds in the undermoderated range (H:Pu ≤ 20). Verification of the calculations was made for the limited criticality data on homogeneous PuO_2 systems in the undermoderated range, and comparisons also made for three heterogeneous plutonium fueled assemblies. (auth)

24184 (ISO-SA-31) WASTE DISPOSAL INTO THE GROUND AT HANFORD. Beard, S. J.; Godfrey, W. L. (Isochem Inc., Richland, Wash.). [1962]. Contract AT(45-1)-1851. 19p. (CONF-670512-1). Dep. CFSTI.

From Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground, Vienna, Austria.

Ground disposal practices currently in use at Hanford for the disposal of low- and intermediate-level liquid and solid wastes are discussed. Low-level liquid wastes are routed to artificial swamps and intermediate-level wastes to underground tile fields which rely on the ion exchange properties of the soil to retain the radioactivity while returning the water to the environment after a delay of several years. Intermediate-level wastes which contain radioactivity that would not be efficiently adsorbed by the soil are released to trenches in limited quantity so that the soil retains the contaminated liquid by absorption. Typical liquid waste disposal costs are $1.40, $700 and $7400 per million liters for swamp, crib and trench disposal, respectively. Waste solids are packaged in cardboard, wood, steel or concrete burial boxes depending on size, weight and radiation intensity. These packages are then buried in disposal trenches. Small size, high-activity solid wastes are packaged in steel drums and placed in underground caissons, while equipment too large to be conveniently disposed of by these methods is loaded on expendable railroad cars and stored in railroad tunnels. Costs for solid waste disposal range from $15 to $3000 per cubic meter depending on the relative complexity of the disposal. The bases for determining the type of disposal method used and the physical features of the disposal systems are reviewed. (auth)

24185 (ISO-SA-32) MIGRATION CHARACTERISTICS OF RADIONUCLIDES THROUGH SEDIMENTS UNDERLYING THE HANFORD RESERVATION. Brown, D. J. (Isochem Inc., Richland, Wash.). [1966]. Contract AT(45-1)-1851. 16p. (CONF-670512-2). Dep. CFSTI.

From Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground, Vienna, Austria.

A field study was made of the production waste disposal site at

Hanford to determine the underground migration characteristics of radioisotopes in liquid wastes. The geology and hydrology of the area were examined. Leaching studies were made. The concentration of strontium-90 and cesium-137 in the sediments and ground water were measured. Ground water samples from some wells showed that the concentration of strontium-90 is at or below 10^{-6} $\mu Ci/cm^3$. The only monitoring wells which showed strontium-90 present in the ground water were those in which concentrations were detected on the soil. Leaching studies show that both strontium and cesium are resorbed in the saturated zone and migrate at very low concentrations. The radionuclides which do eventually migrate downward into the ground water, with the exception of tritium, ruthenium-106, and technetium-99, are quickly dispersed and diffused (and possibly resorbed) in the saturated zone. Radiochemical analyses of ground water samples show that within a kilometer of the disposal sites all nuclides, except those noted, cannot be detected in the ground water using the most sensitive analytical methods. Tritium, technetium-99 and ruthenium-106 have poor sorption properties and migrate at about the same rate as the ground water. The ability to detect these nuclides, at concentrations well below the drinking water limit, using routine analytical methods provides a relatively easy method for defining the flow paths of the slightly contaminated ground water. The contamination plumes, which develop in the ground water as tritium, technetium-99 and ruthenium-106, migrate away from a disposal site and are routinely monitored to determine the concentration changes with time and distance. The results of these studies show that the radionuclides disposed of to ground at Hanford remain safely isolated from the biosphere, and they will remain isolated until, through the natural process of radioactive decay, they are rendered innocuous to man. (auth)

24186 (ORNL-TM-1815) THE DESIGN AND OPERATION OF THE TRANSFER CASE AND RELATED EQUIPMENT IN THE TRANSURANIUM PROCESSING PLANT. Hahs, C. A. (Oak Ridge National Lab., Tenn.). May 1967. Contract W-7405-eng-26. 40p. Dep. CFSTI.

A transfer case has been designed to handle highly radioactive cargo within the limited access area of the Transuranium Processing Plant at the Oak Ridge National Laboratory. This case and its related equipment were developed to make alpha-confined transfers of equipment and material at nine cell cubicles in the cell bank, the decontamination glove box, and the solid waste disposal station. Perhaps the most unique feature of this transfer system is the interchangeability of the large door in the bottom of the transfer case with the mating doors at the 11 transfer stations while using the same method of sealing for all of these doors. The design problems associated with the transfer case and its related equipment, the final design, and the methods of operation devised for this transfer system are described. (auth)

24187 SYMPOSIUM ON WASTE DISPOSAL INTO SURFACE WATERS. Parsons, P. J. (IAEA, Vienna). Nucl. Safety, 8: 249-57(Spring 1967).

The behavior of radioactive wastes released into surface waters is described. The physical and biological transport of radionuclides through such mechanisms as dilution, sedimentation, and current movements or by uptake by biological organisms is discussed. The behavior of radionuclides in surface and deep layers of water is also covered. The ways in which radionuclides, released as waste, may cause a radiation dose to man is described. This may be through movement into the food chain, by introduction into such chains by irrigation, or by external radiation. The evaluation of these main routes of exposure is accompanied by a description of environmental investigations preceding release. The possible effects wastes may have on the resources of the seas through somatic effects on organisms or genetic effects on populations of such organisms is presented. (auth)

24188 TRANSPORTATION OF RADIOACTIVE AND FISSILE MATERIALS. Haff, K. W. Nucl. Safety, 8: 217-19(Spring 1967).

A brief review of newly enacted regulations, 10 CFR 71 and ICC Order 70, concerning the transportation of radioactive and fissile materials is presented. Title 10, Code of Federal Regulations, Part 71, was published in the Federal Register on July 22, 1966, and became effective Aug. 21, 1966; ICC Order 70 was issued on Apr. 25, 1966, and became effective July 12, 1966. (auth)

Vacuum Engineering

Refer also to abstracts 24152 and 24843.

24189 (N-67-16611) EXPERIMENTAL INVESTIGATION OF ULTRA-HIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE. Quarterly Progress Report, October 1-December 31, 1966. Ryan, J. A. (Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.). Contract NAS7-307. 26p. (NASA-CR-81348). CFSTI.

Measurements of adhesion between various silicate minerals whose surfaces have been formed by cleavage in ultrahigh vacuum, and with modifications in the present experimental apparatus to provide further information as to the nature of the adhesional forces acting were made. Of particular note is the highly varied behavior of the long range attractive force which has become more evident. This force field appears often to be anisotropic on a macroscopic scale, forcing the samples into their pre-cleavage orientation even when a significant mismatch is initially present. An electrometer probe is being fabricated for installation in the vacuum system. This probe will be used to obtain plots of the charge distribution over the surface. (STAR)

24190 ELECTRICAL CHARACTERISTICS OF SPUTTER-ION PUMPS. Wear, Kenneth B. (Consolidated Vacuum Corp., Rochester, N. Y.). J. Appl. Phys., 38: 1936-40(Mar. 15, 1967).

Ultra-high vacuum pumps of the sputter-ion pattern were investigated from the standpoint of origin and destination of electrically charged particles constituting pump current. It was found that secondary electron emission is responsible for a large portion of total current, that ion energies range from 0.50 to 0.80 of applied pump potential, and that needle crystals (whiskers) that grow progressively from pump electrodes cause pump current to depart from its linear dependence on pressure. (auth)

24191 METHOD FOR DEGASSING A VACUUM SYSTEM. Linlor, William I. (to U. S. Atomic Energy Commission). U. S. Patent 3,318,512. May 9, 1967.

A method is described for degassing a vacuum system in which an ultrahigh vacuum is to be produced. The method consists of generating a laser beam and focusing the beam on the inner surfaces of the vacuum system and scanning the laser beam over the vacuum surfaces at a rate sufficient to desorb the impurities while pumping the desorbed impurities from the system. (AEC)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 24145, 24410, 24856, 24884, 25399, 25543, and 25750.

24192 (CTH-RF-10) A SYSTEM FOR SIMULTANEOUS MEASUREMENT OF THE AMPLITUDE AND TIME DISTRIBUTION FOR PULSES FROM UP TO FOUR DETECTORS. Grosshoeg, Gudmar (Chalmers Tekniska Hogskola, Goteborg (Sweden). Institutionen for Reaktorfysik). Jan. 1967. 19p. Dep.

A system is described which is used to determine the time dependence of a neutron flux with glass scintillation detectors. (B.G.D.)

24193 (JINR-P13-3225) SISTEMY STABILIZATSII SPEKTROMETRICHESKIKH TRAKTOV. OBZOR PO OPUBLIKOVANNYM MATERIALAM. (Stabilization Systems of Spectrometric Channels. Review of Published Data). Omel'yanenko, M. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 26p. (In Russian). Dep.

All the systems of spectrometric channel stabilization are classified, considered, and compared. (auth)

24194 (NP-16670) ELECTRON-GAMMA AND ELECTRON-ELECTRON COINCIDENCE SPECTROMETERS WITH SEMICONDUCTOR COUNTERS. Bosch, H. E.; Szichman, E.; Baseggio, A.; Dolinkue, R. (Instituto de Investigacione Aeronautica y Espacial, Buenos Aires (Argentina)). Dec. 1966. 19p.

A special vacuum chamber containing a lithium-drifted silicon detector and a radioactive source was designed for electron-gamma coincidences. The gamma rays were detected outside it with conventional scintillation counters. A further modification of this chamber was done placing into it a second silicon detector in front of the former, thus obtaining an electron-electron coincidence spectrometer. Conversion coefficients corresponding to the transitions of 0.161 MeV and 0.0795 MeV in ^{133}Cs were determined. An additional measurement of the conversion coefficient corresponding to the 0.279-MeV transition in ^{203}Tl was performed by means of beta continuum-electron conversion coincidences. The values obtained are: $\alpha_K(0.161) = 0.18 \pm 0.03$(K/LM = 5.2 ± 0.8); $\alpha_K(0.0795) = 1.8 \pm 0.4$(K/LM = 5.5 ± 1.4); $\alpha_K(0.279) = 0.14 \pm 0.03$ (K/LM = 2.4 ± 0.3). (auth)

24195 (PEL-135) Ge(Li)-DETECTORS: A REVIEW OF THEIR PROPERTIES AND OF THEIR APPLICATION IN GAMMA SPECTROMETRY. de Lange, P. W.; Snyman, G. C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Dec. 1966. 26p. Dep. mn.

The properties of planar and coaxial Ge(Li)-detectors in γ-ray spectroscopy are reviewed. Three different cryostat systems to operate Ge(Li)-detectors at low temperatures are compared. Recommendations are proposed for would be users of this new tool in γ-spectrometry. (auth)

24196 (UCRL-17136) COBWEB: IBM-7044/ON-LINE BUBBLE CHAMBER FILM MEASURING MACHINES. Binnall, Eugene P.; Myers, Myron H. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 19, 1966. Contract W-7405-eng-48. 28p. (CONF-660947-2). Dep. CFSTI.

From AEC Information Meeting, New York.

The engineering and programming aspects of the Berkeley COBWEB system are described. COBWEB is a system of Franckensteins and Measuring Microscopes on-line to an IBM-7044 computer. Outlines of the system hardware and software are presented. A brief example illustrating the operation of an on-line Franckenstein is given. (auth)

24197 RELATIVISTIC INCREASE AND PLATEAU OF TRACK DENSITY IN BUBBLE CHAMBERS. Kotenko, L. P.; Merzon, G. I.; Chechin, V. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 5: 815-25(Apr. 1967). (In Russian).

A method for the calculation of track density dependence on the particle velocity in bubble chambers is presented taking into account the polarization of matter. The calculation of the relativistic increase of bubble density is compared with experimental data for propane. The bubble density is found to be proportional to the number of collisions per unit length of track dN/dx accompanied by energy loss $W > W_m \approx 300$ eV. The value W_m is consistent with the calculation of the critical energy necessary for production of a single bubble in superheated propane. The track density dependence on the Lorentz-factor γ of the charged particle in a propane bubble chamber becomes almost constant at $\gamma \approx 100$. The maximum possible relativistic increase is about 20%. (auth)

24198 SIMPLE PROCEDURE FOR COUNTING DOUBLY LABELLED QUENCHED SAMPLES BY LIQUID SCINTILLATION SPECTROMETRY. Hetenyi, G.; Reynolds, J. (Univ. of Toronto). Int. J. Appl. Radiat. Isotop., 18: 331-2(May 1967).

A procedure for simultaneous assay of two β-emitting isotopes in quenched samples, by liquid scintillation counting techniques, has been described by Hendler. The weaknesses of Hendler's method and modifications introduced to minimize their effects were pointed out. A computer was programmed to carry out the involved calculations. The method described uses two channels and an external standard, and does not require computer programming. It is suitable for the assay of samples containing ^{3}He and ^{14}C quenched to a varying and unknown degree, and is also applicable to other pairs of isotopes. (auth)

24199 NEW FORMULA FOR THE GAS AMPLIFICATION IN A PROPORTIONAL COUNTER. Zastawny, A. (Technical Univ., Danzig). J. Sci. Instrum., 44: 395(May 1967).

The new formula previously proposed and verified for CO_2 was verified for measurements taken previously also. On the basis of this verification, and other measurements, it seems that this formula is useful for most gases being used in this field. (auth)

24200 CRITERIA FOR THE SELECTION OF SOLUTES IN LIQUID SCINTILLATION COUNTING: NEW EFFICIENT SOLUTES WITH HIGH SOLUBILITY. Kowalski, E. (Univ. of Bern); Anliker, R.; Schmid, K. Int. J. Appl. Radiat. Isotop., 18: 307-23(May 1967).

The interrelations between different performance parameters of solutes for liquid scintillation counting, such as relative pulse height, relative photon yield, counting efficiency, sensitivity to quenching agents and solubility are first discussed. The performances of new benzoxazoles, benzoxazolyl-thiophenes and oxadiazoles are then reported. Some of the new compounds form very efficient liquid or plastic scintillators, especially with regard to the photon yield, insensitivity to quenching agents and low photochemical degradation. (auth)

24201 COMPARISON OF SOLID-STATE PHOTOELECTRONIC RADIATION DETECTORS. Bube, Richard H. (Stanford Univ., Calif.). Trans. Met. Soc. AIME, 239: 291-300 (Mar. 1967).

Photoelectronic radiation detectors may be conveniently classified as homogeneous intrinsic, homogeneous extrinsic, or junction type. Highly photosensitive homogeneous intrinsic photodetectors may be prepared from a number of different II-VI, III-V, or IV materials. Such materials require the presence of specific imperfections that can act as sensitizing centers to provide long majority carrier lifetime. Homogeneous extrinsic photodetectors are of interest primarily for infrared detection, and consist principally of germanium and silicon with suitable impurities. A variety of junction photodetectors exist, with silicon as the most common material for them all. The following extrema in performance are found: highest photoconductivity gain in homogeneous intrinsic photodetectors; smallest response time (highest frequency response) in p-i-n junctions; and largest gain-bandwidth product in avalanche diodes. (auth)

24202 RADIOSONDE FOR MEASURING COSMIC RAYS IN THE STRATOSPHERE. Ageshin, P. N.; Charakhch'yan, A. N. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 467(1966).

Translated from Geomagn. Aeronomiya, 6: 617(1966).

The circuit of the RK-1 cosmic-ray radiosonde is illustrated and discussed. It was found possible to simplify the circuit without loss of the main quality of the sonde. (J.H.M.)

24203 ANALYSIS OF THE PULSE SHAPE FROM SILICON DETECTORS. Jungclaussen, H. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods, 51: 210-12 (May 1967). (In German).

The pulse shape of silicon n-i-p and n-p detectors bombarded with charged particles is considered. Characteristic parameters which are rather easy to measure are determined. A number of relations connecting these parameters with the depth of the particle penetration into the detector is given. This permits the type of the particle or the incidence angel to be determined. (auth)

24204 RESPONSE OF MU-MESON DETECTORS DEEP IN THE ATMOSPHERE TO PRIMARY COSMIC-RAY PARTICLES OF MAGNETIC RIGIDITY BETWEEN 10 AND 25 GV. Mathews, T.; Sivjee, G. G. (Makerere Univ. Coll., Kampala, Uganda, South Africa). Can. J. Phys., 45: 1643-53(May 1967).

The cosmic-ray mu-meson intensities at three different alti-

tudes at the equator were measured as a function of zenith and azimuth angles by means of a portable scintillation counter telescope of semi-opening angles 23°. The data were analyzed to assess the effects of differences in pi- and mu-meson decay rates on the intensity of the penetrating ionizing component at different zenith angles. It was found that the changes of intensity as a function of zenith angles could be attributed almost entirely to differences in atmospheric absorption, provided that at all zenith angles the threshold rigidities were the same. Hence the intensities measured at different zenith angles in the east-west plane at the equator could be corrected to remove the atmospheric effects and the corrected data used for determining the response of meson detectors at sea level to particles of rigidity up to 25 GV. The response curve thus obtained is presented and compared with that obtained from sea-level latitude surveys by means of ionization chambers. (auth)

24205 PROPERTIES OF PARALLEL-PLATE AVALANCHE COUNTERS FOR MEASUREMENT OF LIFETIMES OF NUCLEAR LEVELS. Krusche, A.; Bloess, D.; Muennich, F. (Technische Hochschule, Brunswick). Nucl. Instrum. Methods, 51: 197-209 (May 1967). (In German).

Properties and performance of a parallel-plate-avalanche-counter are described, as far as they are important for nuclear lifetime measurements. After a short introduction to the physical principles of this detector, a theoretical expression for its time resolution is deduced. It depends, e.g., on the distance of the plates and on the gas in the counter, but not on the energy of the ionizing particles. The experiments performed agree qualitatively with the theoretical predictions. It is shown that an internal time resolution of 3×10^{-10} s can be achieved for this detector. (auth)

24206 ELECTRONIC INSTABILITIES AND THE χ^2 TEST IN SPECTRUM DECOMPOSITION. Quittner, P. (Central Research Inst. for Physics, Budapest). Nucl. Instrum. Methods, 51: 273-6 (May 1967).

An expression accounting for the electronic instability is given for the expected value of χ^2, serving as a check of the least squares fit of the decomposition of complex gamma spectra. It is shown that, depending on the relative contributions from photopeak counts, half width and electronic instabilities, the value of χ^2 may be many times that predicted one from mathematical statistics. The calculations were checked with measurements. (auth)

24207 PLASMA EFFECTS IN SEMICONDUCTOR DETECTORS. Tove, P. A.; Seibt, W. (Uppsala Univ.). Nucl. Instrum. Methods, 51: 261-9(May 1967).

A phenomenological discussion of plasma effects in solid state detectors is given. For the case of weakly ionizing particles and/or high field strengths, it is shown that plasma effects are absent because of immediate polarizations of the tracks, and the simple concept of carrier transit time is valid. For strongly ionizing particles and weak fields, the effects of diffusion of the ionized column and of current erosion from its edge are discussed. Models are set up for the erosion (for planar and cylindrical geometries) in terms of space-charge limited currents from the plasma edge. This leads to expressions for the plasma time as a function of the detector field strength and the carrier density in the track. The results of the cylindrical model, which comply relatively well with experimental results for α-particles, give appreciably shorter times than calculations of ambipolar diffusion. The experimental results for fission tracks, which are short, agree better with three-dimensional erosion geometry. (auth)

24208 FAST COUNTING IN MASS SPECTROMETRY WITH THE SCINTILLATION DETECTOR. Young, W. A. P.; Ridley, R. G.; Daly, N. R. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Nucl. Instrum. Methods, 51: 257-60 (May 1967).

Experience of fast counting in mass spectrometry with the scintillation detector using the 56 AVP (Mullard) and 9495 (EMI) photomultipliers is described. Harwell 2000 series amplifiers and scalers giving a 10 nsec double pulse resolution were used. Problems associated with ion counting with the scintillation detector at count rates above 3×10^4 cps are discussed. (auth)

24209 DETERMINATION OF THE SOURCE ECCENTRICITY IN ANGULAR CORRELATION EXPERIMENTS. Binns, D. C.; Marques, A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nucl. Instrum. Methods, 51: 347-8(May 1967).

A method for elimination of the source eccentricity is presented, which is free from systematic errors, less affected by electronic drift and quicker in application than the usual one. (auth)

24210 MULTIPLE COULOMB SCATTERING INTO A DETECTOR IN CHARGED PARTICLE COINCIDENCE MEASUREMENTS BETWEEN REACTION PRODUCTS. Peelle, R. W. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 51: 315-19(May 1967).

For the case in which the charged particles that strike a circular detector are assumed to be displaced by multiple Coulomb scattering according to a bivariate normal density function, this note displays the fraction of the detected particles that would have struck the detector plane outside a circle of specified larger radius if no scatterer were present. The problem is solved exactly by numerical quadrature, and approximately when the rms displacement caused by the scattering is much less than the detector radius. The latter form may be employed for noncircular detectors. Numerical results are exhibited. The results of this calculation are applicable to experiments in which the particles from a binary reaction are observed in coincidence. Multiple scattering in the target or in an interposed material may cause some of the charged particles striking the first detector to have conjugate particles outside the kinematically prescribed cone which maps the first detector in the plane of the second, and so if no coincidences are to be lost, the second detector must be larger than would be estimated with multiple scattering ignored. This consideration is important to scintillator neutron efficiency measurements by the D(T,^{4}He)n reaction, and the calculation should apply to other experiments in which coincidence detection is used to define the reaction being studied. The results are approximate in that the normal density function is not an accurate description of the multiple scattering. (auth)

24211 AN IMPROVED TYPE OF AUTOMATIC ISODOSE RECORDER. De Roo, M. J. K.; De Bock, A.; Dumoulin, E.; Burin, D. (Univ., St.-Raphael, Belg. Univ., Louvain, Belg.). Ann. Radiol., 9: 635-46(1966). (In French and English).

Efficient radiation therapy is impossible without a perfect knowledge of the dosage distribution in various irradiation circumstances. Only an automatic measurement technique permits accumulation of sufficient data about this matter. In order to satisfy to this need, an automatic isodoseplotter was built. The basic construction schema and the different components of the apparatus are described in detail. Isodosecurves demonstrate the performances of the plotter. The manipulation of the automatic isodoseplotter is simple and necessitates only minor calibration. (auth)

24212 PREPARATION OF A LOW CAPACITANCE Ge(Li) DETECTOR. De Bruin, M.; Hoekstra, W. (Reactor Instituut Delft, Netherlands. Technische Hogeschool, Delft, Netherlands). Nucl. Instrum. Methods, 51: 353-5(May 1967).

The preparation of a low capacitance Ge(Li) detector with a thick depletion layer, using a modified coaxial drifting technique is described. The properties of the detector are demonstrated. (auth)

24213 500-VOLT RESOLUTION WITH A Si(Li) DETECTOR USING A COOLED FET PREAMPLIFIER. Harris, R. J. Jr.; Shuler, W. B. (Coll. of William and Mary, Williamsburg, Va.). Nucl. Instrum. Methods, 51: 341-4(May 1967).

A low-energy gamma-ray spectrometer, consisting of a Si(Li) detector and a cooled FET preamplifier, is described. At low energies (6.4 keV), the system resolution was 0.46 keV. (auth)

24214 SEARCH FOR A FAST DECAY COMPONENT IN NaI(Tl); AN EVALUATION OF THE RCA 8575 PHOTOMULTIPLIER TUBE. Hurley, J. P.; Dagragnano, V. L.; Mathiesen, J. M. (Naval Radiological Defense Lab., San Francisco). Nucl. Instrum. Methods, 51: 299-303(May 1967).

The general performance of selected RCA 8575 photomultiplier tube-NaI(Tl) scintillator combinations was examined. The measurements were made with NaI(Tl) crystals packaged with both glass and quartz windows. The results of the study show that the 8575 is fast, quiet, and shows virtually no internal interaction effects. In addition it was found that the increased light transmission capabilities of the quartz window produced to measurable changes in the measured resolving times. (auth)

24215 PULSE RISE TIMES OF SILICON SURFACE BARRIER DETECTORS. Tove, P. A.; Seibt, W.; Leitz, W. (Uppsala Univ.). Nucl. Instrum. Methods, 51: 304-8(May 1967).

Experimental investigations of the charge collection in surface barrier detectors were undertaken under conditions of α-particle irradiation with normal, and with oblique incidence; from the front, and from the low-field back face. Most of the measurements were undertaken on fully depleted detectors, with and without overvoltage. It is shown that in these cases the pulse rise time agrees with calculations of the charge collection. For the case of overvoltage the results comply with the modified formula $t_r = b(d^3/V)^{\frac{1}{2}}$, taking into account the field-dependent mobility. Under most prevailing conditions the plasma time contributed an insignificant part of the total time. (auth)

24216 NEW METHOD FOR MEASURING THE EFFECTIVE MASS IN THE DECAYS: $x \rightarrow \gamma + \gamma$. Khachaturyan, M. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Azimov, M. A.; Belousov, A. S.; (and others) Nucl. Instrum. Methods, 51: 309-14 (May 1967).

A new method is described for effective mass measurement in the decays: $x \rightarrow \gamma + \gamma$; $x \rightarrow e^+ + e^-$; $x \rightarrow \pi^0 + \gamma$; $x \rightarrow \pi^0 + \pi^0$; etc. with a two-channel system of jointly operating spark chambers and Cherenkov gamma-spectrometers. The system is calibrated for the decays: $\eta^0 \rightarrow \gamma + \gamma$. The $\Delta M/M$ resolution has been obtained to be ±10%. (auth)

24217 MATHEMATICAL REPRESENTATION OF THE PHOTOPEAKS OF GAMMA SPECTRA OF A NaI SCINTILLATOR. Musyck, E. (Centre d'Etude de l'Energie Nucleaire, Mol-Donk, Belg.). Nucl. Instrum. Methods, 51: 320-4(May 1967). (In French).

Having established a mathematical formula representing the modified Gaussian curve of the photopeaks, an attempt is made, by means of the method of least squares, to determine the parameter variations occurring in this formula as a function of gamma radiation in interaction with the NaI scintillator. The introduction of Hermite functions in the mathematical representation causes a fast convergence of the calculations due to the orthogonal properties of these functions. The calculations are done by iterations following the Newton-Raphson method. (auth)

24218 STATISTICAL BEHAVIOR OF THE SCINTILLATION COUNTER: EXPERIMENTAL RESULTS. Bertolaccini, M. (Politecnico, Milan); Bussolati, C.; Cova, S.; Donati, S.; Svelto, V. Nucl. Instrum. Methods, 51: 325-38(May 1967).

An experimental test was made of a theory of the scintillation detector's statistical properties. Mean and amplitude variance of the output current pulse following γ-rays excitation were calculated and measured. The case of non-Poissonian photoelectron distribution and the effect on the mean and variance of the output current pulse of amplitude selection of the charge pulses from the scintillation detector were considered. To test the theory, measurements were made of: the equivalent illumination, the single electron response, the gain of the electromultiplier and its variance, the mean and variance of the selected output charge distribution. From these measurements, mean and variance of the output current pulse as a function of time were calculated and compared with the same quantities measured directly. The good agreement between theoretical and experimental results support our theoretical model for the behavior of the scintillation counter. It is concluded that to describe the statistical behavior of the scintillation counter it is sufficient to know the following parameters: equivalent illumination, single electron response, gain of the electronmultiplier and its variance, mean and variance of the selected output spectrum. (auth)

24219 DISCHARGE-CLOUD METHOD FOR DETECTION OF CHARGED PARTICLE TRACKS. Manjavidze, Z. Sh.; Roinishvili, V. N. (Inst. of Physics, Tbilisi, USSR). Phys. Lett., 24B: 492-3(May 1, 1967).

A new discharge-cloud method to detect tracks of charged particles is described. The chamber, constructed on the basis of discharge-cloud method, has high time resolution of events (the order of some microseconds) and long memory for the selected event (the order of tens of a millisecond). Photos of cosmic ray particle tracks obtained in a discharge-cloud chamber are given. (auth)

24220 DETERMINATION OF THE ABSOLUTE DOSE IN Al AND Cu IN BOMBARDMENT WITH MONOENERGETIC β PARTICLES WITH THE INITIAL ENERGY OF 0.5 UP TO 1 MeV. Parak, Fritz; Luchner, Karl (Technische Hochschule, Munich). Nukleonik, 9: 25-9(Jan. 1967). (In German).

The dose-depth distribution caused by bombardment with monoenergetic electrons in semi-infinite expanding medium (Al and Cu). was measured using a very flat ionization chamber. The disturbing effect of the ionization chamber on the electron flux was considered technically in the measurements so that measurements were made with various chamber depths and extrapolation to the chamber depth of 0. A new determination of the specific ionization made possible an absolute estimation of the dose per incident electron. Within a wide energy range the dose curves for Al have about the same form approximately Gaussian function so that they can be normalized to each other without large errors. A comparison with results from theoretical calculations of Meissner made on Al at 1 MeV shows agreement in the surface dose and extrapolated range but not in the form of the curve. (tr-auth)

24221 NUCLEAR RADIATION DETECTORS BASED ON IMAGE INTENSIFIERS. Medvedev, M. N. (Joint Inst. of Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk, 90: 143-61 (Sept. 1966). (In Russian).

A review is presented which is devoted to papers published in the last eight or nine years on nuclear radiation detectors employing image intensifiers and to a description of the results of several applications for these detectors. Both Western and Soviet image intensifiers are described. Most of the scintillation chambers described are of Western manufacture. A Cherenkov detector is also described. The applications discussed are determination of the geometry of charged-particle beams produced in accelerators, study of the decay of ^{12}B and measurement of the angular distribution of charged particles in a given solid angle. Seventy references are included. (ATD)

24222 QUANTITATIVE PARTICLE COUNTERS WITH A NEUTRON CHAMBER. Ernst, M.; Christ, J.; Schmatz, W. (Technische Hochschule, Munich. KFA, Juelich, Ger.). Nukleonik, 9: 29-35(Jan. 1967). (In German).

The light flash arising in a $^6LiF-ZnS(Ag)$ detection layer can be counted quantitatively as the darkening point on a photographic plate with an accuracy of at least 3%. At a neutron wave length of 8 Å from the incident neutron there is a detection probability of about 30%. Neutron photography is therefore very suitable for the measurement of weak intensity fields, so that it opens a further application range, especially in differentiated diffraction structures. (tr-auth)

24223 CURVES FOR THE RESPONSE OF A Ge(Li) DETECTOR TO GAMMA RAYS IN THE ENERGY RANGE UP TO 11 MeV. Kopecky, J.; Ratynski, W.; Warming, E. (Atomic Energy Commission Research Establishment, Risoe, Denmark). Nucl. Instrum. Methods, 50: 333-9(1967).

The response function of a Ge(Li) coaxial detector with a sensitive volume of 17 cm^3 for gamma rays of energies ranging from 2.23 to 10.83 MeV was determined. The measurements were carried out with an experimental set-up using the neutron beam from the DR 3 reactor at Risö and the (n,γ) reaction as gamma-ray source. The important features of the spectra are discussed, and the double-escape peak efficiency is determined. (auth)

24224 PROPORTIONAL COUNTER DESIGN: RADIOCARBON DATING. Watt, D. E. (United Kingdom Atomic Energy Authority, Chapelcross, Scotland). Nucl. Instrum. Methods, 50: 353-4(1967).

Attention is drawn to the fact that few proportional counters at present in use have E/p (V/cm,Torr) values at the cathode sufficient to ensure saturation collection of the ions and the consequences on counter operation are discussed. The design of a new radiocarbon dating counter is described. (auth)

24225 A STILBENE FAST NEUTRON SPECTROMETER FOR THE STUDY OF THE NEUTRON SPECTRUM OF A Pu–Be SOURCE. Haas, F. X. Jr. (Mound Lab., Miamisburg, Ohio); McCarthy, J. T. Contract AT(33-1)-Gen-53. Nucl. Instrum. Methods, 50: 340-2(1967). (MLM–1384J).

The neutron spectrum from a Pu–Be neutron source was obtained using a stilbene scintillator. Pulse shape discrimination between γ-ray and neutron-produced pulses is obtained by using the difference in crossover point of the doubly differentiated pulses produced by these two types of particles. The neutron spectrum obtained compares well with other published Pu–Be neutron spectra. (auth)

24226 TRANSISTORIZED NUCLEAR COUNTING INSTRUMENTS FOR A LOW-LEVEL COUNTING LABORATORY. Ragupathy, S. (Atomic Energy Establishment, Trombay, India). Nucl. Instrum. Methods, 50: 325-32(1967).

Simple transistorized circuits adaptable for low-level counting work are described. These include: a dekatron scaler with five decades; a low background beta counting system with coincidence and anticoincidence circuits; a single channel pulse height analyzer for gamma spectrometry. The performance of these circuits in low-level counting work is also reported. The special features of the circuits described are their simplicity, good long-term stability and reliability, with fastness adequate for most types of low-level counting work. (auth)

24227 METHOD FOR AUTOMATIC IDENTIFICATION OF PEAKS IN THE PRESENCE OF BACKGROUND AND ITS APPLICATION TO SPECTRUM ANALYSIS. Mariscotti, M. A. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Nucl. Instrum. Methods, 50: 309-20(1967). (BNL–10441).

A computer method is described that permits automatic analysis of high resolution spectra, provided that the data are stored in a way suitable for computer input (i.e., on magnetic or paper tape). The program reads the entire spectrum, locates the peaks and determines their amplitudes, centroids and widths by least squares fitting. Doublets are handled automatically. (auth)

24228 INEXPENSIVE MOESSBAUER SPECTROMETER. Beltran-Lopez, Virgilio; Loria, Giorgio (Centro Nuclear Comision Nacional de Energia Nuclear, Mexico). Rev. Sci. Instrum., 38: 707(May 1967).

An inexpensive Moessbauer spectrometer is described in which the usual multichannel analyzer is substituted by an oscilloscope and a photographic camera. (B.G.D.)

24229 HIDDEN EXPLOSIVES DETECTOR UTILIZING LONG-LIVED RADIOACTIVE TRACER MATERIAL. Jordan, Edward D.; Cowan, Clyde L. (to U. S. Atomic Energy Commission). U. S. Patent 3,308,296. Mar. 7, 1967.

Apparatus is described for detecting explosives hidden in luggage. The apparatus has liquid scintillator detectors which are able to receive radiations from radioactive tracers seeded in the explosives. The scintillators are connected to "and-or" circuits which are connected through a common coincidence circuit to a counter. The circuit discriminates against energy outside of a selected range to eliminate background radiation. (AEC)

24230 SELF-CHECKING IONIZATION CHAMBER TYPE RADIATION DETECTOR. Brodsky, Robert S. (to U. S. Atomic Energy Commission). U. S. Patent 3,317,823. May 2, 1967.

A self-checking ionization chamber-type radiation detector consisting of a controllable source of electrons disposed within an ionization chamber, and upon energization of the source emits electrons ionizing the surrounding gas thereby providing a current in the measuring and utilization circuitry is described. (AEC)

24231 SURFACE-BARRIER DIODE FOR DETECTING HIGH ENERGY PARTICLES AND METHOD FOR PREPARING SAME. Fox, R. J.; Borkowski, C. J. (to U. S. Atomic Energy Commission). U. S. Patent 3,320,495. May 16, 1967.

A surface-barrier diode detector which has increased depth and improved resolution for detecting high energy particles and which effectively reduces electrical noise at higher bias voltages employed by isolating the detector region from the border of the silicon semiconductor is described. (AEC)

24232 EXPERIMENTELLE METHODEN DER KERNPHYSIK. (Experimental Methods in Nuclear Physics). Stoll, P. Heidelberger Taschenbuecher Band 11. Berlin and Heidelberg, Springer-Verlag, 1966. 185p. DM 10.80.

Units for radiation measurement and dosimetry are given, and shielding problems with γ rays and neutrons are discussed. Detectors for identification and for spectroscopy of nuclear radiation are described including: ionization chambers, electronic counters and measuring apparatus, technical aspects and operation of gas-filled detectors, network elements, scintillation counters, Cherenkov counters, semiconductor detectors, photographic plates, and bubble chambers. Coincidence measuring techniques are considered. The activation method as a means for determination of neutron flux is outlined. Uses of radiation sources in nuclear physics are reviewed. Magnetic and electric fields as aids in particle focussing and separation are considered. (M.C.G.)

Radiation Dosimeters

24233 DOSIMETRY OF π MESONS. Goebel, K. Z. Naturforsch., 21a: 1808-19(1966). (In German).

Ionizing radiation with high linear energy transfer capacities and small O_2 factor is of significance for therapeutic use. The radiation produced in the absorption of stopping π^- mesons has these properties. The physical processes in capture are strongly dependent on the absorbing nuclei. Measurements of the energy absorbed in the capture of π mesons were described. By comparison of the energy dose which occurs in the capture of positive and negative π mesons, the fraction of the dose caused by the nuclear process was estimated. The applicability of the Bragg–Gray principle to the measurement of this nuclear dose and the significance of the tissue equivalence were discussed. On a comparison of the focal dose to the entry dose for various radiation types it was shown that π^- beams of a kinetic energy from 50 to 80 MeV at depths from 10 to 20 cm yield the best ratios. (tr-auth)

24234 METHOD OF DETERMINING THE FAST NEUTRON DOSE EQUIVALENT. De Franceschi, L. (CAMEN, Pisa, Italy). Nucl. Instrum. Methods, 50: 321-4(1967).

A method to determine the fast neutron dose equivalent (DE) by using experimental data gained with the Hurst proportional counter is described. Such data have till now been extensively employed to measure tissue first collision dose. The DE determination is accomplished deducing from proportional counter data the LET spectrum of H and C recoils, calculating through them the mean quality factor for first collision (fc) dose and then arriving at the DE by means of a build-up factor. A graphical simplification makes the method very practical. (auth)

24235 AQUEOUS SOLUTIONS OF POTASSIUM PEROXYLAMINE DISULPHONATE FOR DOSIMETRY OF ACCELERATED ELECTRONS. Sharpaty, V. A.; Margolin, D. M.; Zakatova, N. V.; Yanova, K. G. (Karpov Inst. of Physical Chemistry, Moscow). pp 187-95 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

For dosimetry of accelerated electrons, studies were carried out on aqueous solutions of the stable radical potassium peroxylamine disulfonate (PADS) ($O = N(SO_3K)_2$) (potassium nitrosodisulfonate) to examine the reproducibility of dosimeter readings when technical operation of the accelerator is varied and to calibrate the readings of the accelerator on the available standard dosimeter. The work of the dosimeter system PADS-water is based on the interaction of PADS ion with the oxidizing and reducing products of water radiolysis, and the decrease of PADS depends linearly on the radiation dose. The effect of the additives, salts of some oxyacids, $KClO_4$, NaH_2PO_4, Na_2SO_4, and $NaNO_3$ was tested. The system PADS-water containing NO_3^- and SO_4^{2-} is recommended for dosimetric purposes. (B.L.M.)

24236 CHEMICAL EFFECTS OF SHORT ELECTRIC PULSE DISCHARGES IN THE FRICKE DOSIMETER. Zagorski, Z. P.; Grodkowski, J. (Inst. of Nuclear Research, Warsaw). pp 175-9 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The influence of an electric discharge of a millisecond duration on the classic Fricke system was determined, as were the yields in relation to the delivered energy. The observed phenomena were qualitatively identical with those found when the system was subjected to ionizing radiation, and no difference was noted in the yield when the solution was saturated with oxygen instead of air. From the estimation of the depth of the discharge zone determined by photography and from extrapolation of the chemical results, the density of the transferred energy is estimated at 8×10^{22} eV/ml and the dose rate at 10^{25} to 10^{26} eV/ml. It was concluded that only about 3% of this transferred energy was in a form analogous to ionizing radiation with the majority of the energy being changed into chemically useless heat. (B.L.M.)

24237 INVESTIGATION OF THE OXALIC-ACID SYSTEM FOR HIGH DOSE RATE ELECTRON DOSIMETRY. Sehested, K.; Bjergbakke, E.; Holm, N. W. (Atomic Energy Commission Research Establishment, Risoe, Denmark). pp 149-60 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

Aqueous solutions of oxalic acid were applied to electron dosimetry from electron linear accelerators up to a dose rate of $\sim 10^{11}$ RAD/sec during the electron pulse. The calorimetric technique was used for the determination of absorbed dose with the irradiation vessel itself filled with the dosimetric solution as the calorimetric body. A number of experiments were also carried out with a bent and scanned beam where the average dose rate in the pulse was 2×10^9 RAD/sec. The analytical methods applied to the dosimeter and the use of an equation relating to the chemical yield and absorbed dose are discussed briefly. The primary products were identified as glyoxal and glyoxylic acid, and a reaction scheme is suggested. Some suggestions are given with regard to the dosimeter procedure. (B.L.M.)

24238 ADJUSTABLE WIDE RANGE RADIATION LEVEL ALARM. Genert, William (to U. S. Atomic Energy Commission). U. S. Patent 3,319,066. May 9, 1967.

A radiation dosimeter, adjustable over a wide range of radiation levels, is described which includes means to compare the output of an ion-chamber with the output of a pulser which recharges the ion-chamber whenever the detected dosage is less than a set amount during the interval between pulses, causing an alarm to sound. (AEC)

24239 DOZIMETRICHESKIE I RADIOMETRICHESKIE METODIKI. (Dosimetric and Radiometric Methods). Gusev, N. G.; Margulis, U. Ya.; Marei, A. N.; Tarasenko, N. Yu.; Shtukkenberg, Yu. M. (eds.). Moscow, Atomizdat, 1966. 444p.

A detailed description is given of the methods, techniques, and instruments used in present dosimetric and radiometric analyses. The topics considered are sanitation-dosimetric controls of the state of the external media; determinations and methods of sanitation inspection of the external media exposed to the contamination of radioactive substances; methods for the determination of radioactive materials in water, soil, biomaterials, and air; radiochemical and chemical methods for the determination of some radioactive elements in air; physical methods for the determination of the contamination of air by radioactive aerosols and gases; methods for the measurement of the contamination levels of surfaces; methodics of the measurement of external radiation currents; methods of individual dosimetric controls, and absolute and comparative methods for the measurement of the activity of solid and liquid radioactive sources. In an appendix the determination

of total doses from internal and external sources, preparation of samples of thick β sources, preparation of sources from films of potassium and their use for calibration of radiometric devices, and preparation of samples for β counting using scintillation gels were reported. (J.S.R.)

Radiometric Instruments

Refer also to abstracts 24112, 24152, 24172, 24177, and 24239.

24240 NEUTRON SOIL MOISTURE GAUGES. Zuber, A. (Inst. of Nuclear Research, Krakow); Cameron, J. F. At. Energy Rev., 4: No. 4, 143-67(Dec. 1966).

Theoretical and practical factors involved in selecting and using neutron soil moisture gages are considered. These factors include range of moisture contents to be measured, variations in soil and measurement parameters, methods of calibration, and optimum measuring times. A comparison is made of some typical moisture gage designs. (auth)

24241 WEIGHT PER UNIT AREA GAGE WITH ABSOLUTE INDICATION. Vogt, W. (VEB Vakutronik WIB, Dresden). Isotopenpraxis, 3: 47-9(Feb. 1967). (In German).

A laboratory model of an actual-value indicator (absolute value meter) for measuring the mass per unit area is described. The indicator may be operated in connection with all measuring heads of the mass per unit area gages designed and manufactured by VEB Vakutronik WIB Dresden. The working principle of the gage based on a programmed control is described. Using this indicator the same accuracy is attainable as that of the well-known deviation indicators usually used in connection with the mass per unit area gage VA-T-70B. (tr-auth)

24242 DEEP WATER ISOTOPIC CURRENT ANALYZER II (DWICA II) (Engineering Materials). (Johnston (William H.) Labs., Inc., Baltimore, Md.). (CAPE-1492).

55 drawings.

The deep water isotopic current analyzer (DWICA II) is pressure protected for use to depths of 1000 fathoms. The apparatus contains a submerged computer for full automation of data including processing, storage, and transfer to the surface where it is printed out on paper tape. DWICA II measures the speed of ocean currents and current direction. (For details see TID-4100 Suppl. 40) (F.S.)

Miscellaneous Instruments and Components

Refer also to abstracts 24138, 24153, 24154, 24774, 24983, and 24996.

24243 (BNL-11277) BROOKHAVEN DIGITAL COMMUNICATIONS NETWORK. Fannin, K. R. (Brookhaven National Lab., Upton, N. Y. [nd]. Contract AT-30-2-GEN-16. 13p. (CONF-670408-1). Dep. CFSTI.

From AEC Computer Information Meeting, Houston, Tex.

A survey of the composite requirements of a data transmission system from the experimental areas to the Central Computing Facility at BNL is presented. (B.G.D.)

24244 (CEA-R-3094) MESURE D'UN FLUX DE PARTICULES NEUTRES PAR UNE METHODE THERMIQUE METTANT A CONTRIBUTION L'EFFET DE TEMPERATURE DES JONCTIONS. (Measurement of a Neutral Particle Flux by a Thermal Method Using the Junction Temperature Effect). Caron, Anthime (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1966. 74p. (In French). Dep.

Thesis. Submitted to Besancon Univ., France. Faculte des Sciences.

Among all the methods suitable for measuring neutral particle fluxes obtained by proton charge exchange in an organic gas, the thermal method was chosen. The energy imparted by the neutral particles to the target in the form of heat leads to the latter's temperature increasing; this temperature is usually followed with a thermocouple. In order to increase the sensitivity and the elegance of the apparatus the thermocouple was replaced by a junction whose characteristics are known to vary with temperature. A calibration is carried out using a beam of charged particles. The response obtained is linear. Measurements were made with a power of up to 1 MW; the accuracy increases with the energy provided; for 4 joules an accuracy of 10 per cent is obtained. The apparatus may be improved in particular by extending the measurement range toward low power values, and by increasing the accuracy. (auth)

24245 (CEA-R-3143) QUELQUES RESULTATS SUR L'EFFET PHOTOELECTRIQUE EXTERNE ET L'EMISSION SECONDAIRE. (Some Results Concerning the External Photoelectric Effect and Secondary Emission). Lenouvel, Francois (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1967. 74p. (In French). Dep. mn.

The characteristics and limiting possibilities of the various constituent parts of a photoelectric detector are considered. Two methods for illuminating the cathode are described and discussed. The few scattered results concerning the maximum output of cathodes and dynodes are collected together and a tentative explanation is put forward. A comparison is made of three methods for measuring very low light fluxes. (auth)

24246 (ISS-66/43) GENERATORE DI NUMERI A CASO. (Type of Random Number Generator). Felici, C.; Gricia, P. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Nov. 12, 1966. 11p. (In Italian). Dep.

A random number generator circuit, based on the use of the noise of an amplifier which is sent to a pulse shaper circuit, in such a way to randomly vary the duration of the signal given by the circuit (1.8 ms on the average) of about 10% is described. This signal puts on a gate circuit at the input of which is always a signal of 10 MHz frequency. In this way the wave train duration at the output of the gate, and therefore the number of the pulses in it, vary randomly. (auth)

24247 (JINR-P13-3246) OVOZMOZHNOSTI ISPOL'ZOVANIYA TRANZISTORNOGO GTA V KACHESTVE ISTOCHNIKA REPERNYKH IMPUL'SOV V SISTEMAKH STABILIZATSII SPEKTROMETRICHESKOGO TRAKTA. (On the Possibility of Using the Transistorize Accurate Amplitude Generator as Source of the Reference Pulses in the Stabilization Systems of the Spectrometer Channel). Imaev, E. G.; Prikhod'ko, V. I.; Tishin, V. G.; Fefilov, B. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1967. 14p. (In Russian). Dep.

Stability of the pulse amplitude of the accurate amplitude generator is investigated at different regimes of turning on the transistors and different formation time constants in the spectrometer channel. The calculation and experimental data are presented. The stability of the pulse amplitude of the accurate amplitude generator was received to be $\approx 0.02\%/10°C$. (auth)

24248 (N-67-11333) DEVELOPMENT OF HIGH SPEED FLUERIC LOGIC CIRCUITRY FOR A NOVEL PNEUMATIC STEPPING MOTOR. Griffin, William S.; Cooley, William C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1966. 38p. (NASA-TM-X-52250; CONF-670510-1). CFSTI.

From Symposium on Fluidics, Lafayette, Ind.

Under a NASA-Lewis Research Center program aimed at nuclear rocket control drum actuator, a novel, pneumatic stepping motor was developed. Improved high speed flueric logic circuitry to drive the motor and the breadboard performance of the logic circuitry-stepping motor system are described. The pneumatic stepping motor actuation system is compared with the more conventional pneumatic piston-in-cylinder actuator. (auth)

24249 (N-67-14925) FABRICATION AND TEST OF A FLUERIC POSITION SERVO. Progress Report, December 10, 1965-June 10, 1966. Erwin, L. R. (Bendix Corp., Southfield, Mich. Research Labs. Div.). June 10, 1966. Contract NAS3-6201. 31p. (NASA-CR-72129; BRLD-3512). CFSTI $3.00 cy, $0.65 mn.

A program to develop a pneumatic control drum actuator for a nuclear rocket engine in which the electronics have been replaced by flueric devices is reported. The detailed drawings for the position error detector unit and power control valve were released. Many purchased items have been received and a number of machined parts have been completed. Improvements were made on the flueric vortex pressure amplifiers. A breadboard lead-lag circuit was built and tested. (auth)

24250 (NP-16712) COMMUNICATIONS EQUIPMENTS AND SYSTEMS TO SUPPORT INTRASTATE CIVIL DEFENSE OPERATIONS: CIRCA 1970. Final Report. Cone, Donald R.; Baer, James A.; Shapiro, Elmer B. (Stanford Research Inst., Menlo Park, Calif.). Dec. 1965. Contract OCD-PS-64-201. 100p.

A compilation is presented of data covering both wire and radio facilities of value for civil defense application. The general characteristics of the items are discussed and their potential application in a representative communications or command and control model is illustrated. Representative costs are provided. The discussion of the various communication systems and typical items of equipment generally identifies their salient operational strengths and weaknesses. A number of conclusions and recommendations

relative to existing and potential CD communications systems and equipments are presented. (auth)

24251 SURVEY OF COUNTERS. PART 2. Whyte, A. B. Eng. Mater. Des., 10: 229-35(Feb. 1967).

A survey is made under the following headings: electromagnetic impulse counter (predetermining counters, printing counters); Mounting; Terminology; Electronic counters (totalling and batch counters, frequency, period, time and ratio counters, scaler timers). A guide to manufacturers is included. (auth)

24252 CHOICE OF OPTIMAL CHANNEL WIDTH IN MEASUREMENTS WITH A SINGLE-CHANNEL ANALYZER. Potschwadek, B. (Univ., Rostock, Ger.). Atompraxis, 13: 118-21 (Mar. 1967). (In German).

The data available so far on choice of channel width are unsatisfactory. The derivations given here are based on the assumption that the energy distribution of a peak follows a Gaussian distribution pattern, and that Sheppard's correction is valid for large channel widths. Proportionality between background and channel width is demonstrated experimentally, and it is shown theoretically that the background is independent of the half-value width of the measuring instrument. This makes it possible to give an analytic expression for the background, and especially for the preparation effect, in which all important parameters are standarized to the relative half-value width. If these expressions are substituted in the quality functions, a number of practical deductions can be obtained. (auth)

24253 HIGH RESOLUTION PIEZOELECTRIC PRESSURE PROBE. Katsaros, W. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Z. Angew. Phys., 22: 537-44(1967). (In German).

A special piezoelectric probe is described having a time resolution of 80 nsec and a special resolving power of about 1 mm at a sensitivity of 5 torr/mV. For calibration in an absolute scale a new method was developed using a piezoelectric shock generator which allows a calibration of the probe with an accuracy of ±10%. Applications of the probe are reported for the direct measurement of the pressure in cylindrical shock waves which were produced in an inverse Z-pinch experiment. (auth)

24254 FLUOROSCOPY WITH A MARCONI 12-IN. IMAGE AMPLIFIER AT 15 MeV AND 18 MeV. Wycherley, J. R.; Shemmans, M. J. (GKN Group Research Lab., Wolverhampton, Eng.). Appl. Mater. Res., 5: 195-9(Oct. 1966).

Experiments were carried out on an 18-MeV betatron and on a 15-MeV linear accelerator. The study was a continuation of that performed at lower x-ray energies but, at these higher x-ray energies, particular attention was paid to the problem of hot bloom inspection of steel. Earlier trials performed with a 12-in. image amplifier and a 5-MeV linear accelerator yielded DIN wire sensitivities better than 1% in the range 2.5 to 6 in., with best results of 0.6% in the range 4 to 7 in. However, these results were obtained for a screen-focus distance of 1 m with the television system and the linear accelerator working near their limits. Engineering difficulties made it desirable to use a screen-focus distance longer than 1 m, which would mean a resultant drop in sensitivity. These earlier trials were encouraging, but a bigger margin of safety was desirable for continuous on-line bloom inspection. The fluoroscopic performance of higher energy x-ray machines was explored to see whether there would be any advantage in using such a machine. The most significant finding from both the linear accelerator and the betatron trials was the superiority of lead-backed screens at the energies used. Particularly with the linear accelerator, they enabled the wire sensitivity achievable with the fluoroscopic unit to approach that of fine grain film. At this early stage of development, however, the quality of the image is certainly not comparable with that of film, for reasons which are discussed. (BBB)

24255 DEVELOPMENT AND CONSTRUCTION OF GERDIEN CONDENSER ROCKET PROBES. Pedersen, A.; Oeberg, B. (Uppsala Ionospheric Observatory). pp 33-45 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

Information is presented on the design and construction of condensers for collecting ions in the ionosphere. Construction of 2 different types of Gerdien condenser rocket probes and their instrumentation racks is described. In this cylindrical condenser for measurements of ion conductivities and concentrations, the ionized air passes through the condenser and the ions are collected in its electric field. Information about the ions is derived from the measured current-voltage characteristics. Conductivity measurements apply in the dense atmosphere, where the mean free path is smaller than the probe, i.e., below 80 to 85 km. The probes descend in inflatable parachutes after expulsion from Booster Arcas rockets between 80 and 90 km. The electronic circuits including electrometer, amplifiers, and commutator units for driving voltage sweeps and for operation of switches are described in detail. The packing of units and procedure before launch is mentioned. Instrumentation rack temperatures were measured during 4 experiments, and temperature increases of the order of 20°C were found. (BBB)

24256 INFLATABLE MYLAR PARACHUTES FOR HIGH ALTITUDES. Pedersen, A. (Uppsala Ionospheric Observatory). pp 46-59 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

An inflatable parachute system was developed for deceleration of an ionospheric probe instrumentation descending from 80 to 100 km height after expulsion from a Booster Arcas rocket. Inflation of the parachute is achieved by a torus fastened close to the leading edge of the parachute. The torus can be blown up with residual air or with water vapor. Constructional details of the parachute and expulsion mechanism are included. The parachute behavior after expulsion is also discussed, and descent rates calculated. The parachute performance is described for 3 experiments at White Sands Missile Range, USA, and for 2 experiments at Andoya, Norway, with a reinforced type of parachute. (BBB)

24257 SODIUM–LITHIUM POINT CLOUD PAYLOAD. Derblom, H. (Uppsala Ionospheric Observatory); Lamnevik, S.; Hellmouth, O. pp 96-9 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

The development of a payload with a total weight of 9 lbs for release of sodium and lithium is described. Self-acting decomposition of sodium and lithium azides is used as the principle of the generator. Observations from the first launching indicate that it is necessary to increase the payload efficiency. (auth)

24258 INSTRUMENTS FOR NIGHT STUDIES OF UPPER ATMOSPHERE LIGHT EMISSIONS. Stoffregen, W.; Derblom, H. (Uppsala Ionospheric Observatory). pp 100-7 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

A spectrophotometer, photometers, and an all-sky camera designed for night sky studies of upper atmosphere light emissions are described. (J.H.M.)

24259 FLUOROSCOPY WITH A MARCONI 12-IN. IMAGE AMPLIFIER AT ENERGIES UP TO 5 MeV. Vincent, B. J. (Royal Armament Research and Development Establishment, Fort Halstead, Eng.); Shemmans, M. J. Appl. Mater. Res., 5: 172-80(July 1966).

Some theoretical and practical aspects of industrial fluoroscopy at energies up to 5 MeV are discussed from both radiographic and electronic aspects. The safety afforded by remote viewing on a closed circuit television system has made it possible to extend the field of fluoroscopy to applications involving dense specimens and high-energy x-ray sources. Preliminary trials were carried out with an image orthicon television camera used to view an electrostatic image brightness intensifier. This equipment was used in conjunction with a Mullard 5-MeV linear accelerator capable of a maximum output of 600 R/min at 1 m. Three other sources were also investigated: ^{60}Co, and 400-KV and 1-MeV x-ray generators. To improve the performance of such a unit, methods of improving the number of x-ray quanta absorbed in the primary screen were considered, also means of improving the light output from this screen. The most fruitful field of development seemed to be in improvements to the primary screen to enable it to absorb a larger proportion of the incident radiation and produce a light image. An experimental screen was constructed from 1 mu dia fibers of NE.102 scintillating plastic. A liquid channel screen was also designed. Brightness measurements were made. For ^{60}Co at 50 cm, brightnesses ranged from 0.03 to 0.39 mft-lamberts, while brightnesses of the order of 1 mft-lambert were observed with both the 1-MeV and the 400-KV generators. Wire penetrameter sensitivities for steel at 5 MeV were determined. In the range of thickness 3 to 7 in., sensitivities comparable with those obtained with film can be achieved. Sensitivities better than 1% can be obtained for the range 2½ to 9 in. (BBB)

24260 THIRD TRANSISTOR GIVING BETTER STABILITY TO MULTIVIBRATORS. Colombo, A. (CCR-EURATOM, Ispra, Italy). Nucl. Instrum. Methods, 51: 349-50(May 1967).

A simple method for achieving a synchronized time base generator with stability better than ±0.05% for 40°C of temperature variation, using a normal power supply, is described. (auth)

24261 PROPOSAL FOR THE REDUCTION OF HYSTERESIS IN AMPLITUDE DISCRIMINATORS. Nizan, A. I. (Ministry of Defence, Tel-Aviv, Israel); Elad, E. Nucl. Instrum. Methods, 51: 270-2(May 1967).

A method for the reduction of hysteresis in discriminators is proposed. The application of this method in the case of a Schmitt trigger circuit is demonstrated and it is shown that a two order of magnitude hysteresis reduction is easily obtained. Because of its general form, it is felt that this method of hysteresis reduction might be applied to a variety of discriminator types. (auth)

24262 SIMPLE REALIZATION OF A SLIT WITH MICROMETRIC SYMMETRIC OPENING. Frilley, M. (Institut du Radium, Paris). Nucl. Instrum. Methods, 51: 345-6(May 1967). (In French).

A description of a micrometric and symmetrical opening slit is given. The device can be built rapidly with usual machining tools; nevertheless, it presents good characteristics. (auth)

24263 COMPUTER FACILITY FOR NUCLEAR PHYSICS DATA COLLECTION AND ANALYSIS. Murray, G. L.; Macefield, B. E. F. (Oxford Univ.). Nucl. Instrum. Methods, 51: 229-37(May 1967).

A medium size digital computer is used in a time-shared mode for real-time data collection and independent background computation. (auth)

24264 BIPRISM-INTERFEROMETER FOR 100 keV ELECTRONS AND ITS APPLICATION. Kerschbaumer, Egon (Univ., Tuebingen, Ger.). Z. Phys., 201: 200-8(1967). (In German).

A biprism-interferometer for 100 keV electrons working with magnetic quadrupole lenses is described. With this instrument the mean inner potentials Φ of Cu and Au were measured. Values of $\Phi = (20.2 \pm 0.7)$ V for Cu and $\Phi = (16.8 \pm 1.0)$ V for Au were found. (auth)

24265 INVESTIGATION ON LINEAR GATE CIRCUITS. Fricke, K.; Viehl, E. (Technische Hochschule, Brunswick). Nukleonik, 9: 58-60(Jan. 1967). (In German).

Three circuits of transistorized gates were investigated and complete circuit diagrams were given. The linearity, stability, maximum pulse repetition, pileup, and platform formation were measured and discussed. A gate circuit with six diodes was the most serviceable and stable. (tr-auth)

24266 PHOTOMULTIPLIER WITH HIGH RESOLUTION USING A SEMICONDUCTOR MULTIPLIER. Chevalier, P. (Laboratoire d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). Nucl. Instrum. Methods, 50: 346-8(1967). (In French).

A photomultiplier in which the output signal corresponding to 1, 2, 3 ... n photoelectrons emitted by the cathode are distinguished without confusion by their amplitude is described. Pending the realization of other tubes, these first results are presented. (auth)

24267 METHOD FOR OPTICALLY COUPLING A 5 IN. PHOTOMULTIPLIER TUBE. Bowen, T.; Krider, E. P.; York, J. W. (Univ. of Arizona, Tucson). Nucl. Instrum. Methods, 50: 349-50(1967).

A simple method for optically coupling a 5 m diameter photomultiplier tube to acrylic plastic was developed which should also be suitable for coupling to any scintillator plastic or glass surface. The technique also provides for easy mechanical mounting of the photomultiplier and its magnetic shield. (B.G.D.)

24268 TANDEM ISOTOPE SEPARATOR-MASS SPECTROMETER FOR THE STUDY OF IONIC COLLISION PROCESSES. Moran, T. F.; Friedman, L. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Rev. Sci. Instrum., 38: 668-76(May 1967). (BNL-10572).

An isotope separator and mass spectrometer system has been assembled for the study of ionic collision processes over an energy range of 0.25 to 60,000 eV. This system consists of an isotope separator capable of delivering intense, well resolved beams of mass analyzed ions into a collision chamber which serves as the source for the analyzing mass spectrometer. This experimental arrangement provides good energy resolution of the primary ion beam and efficient collection of the products of reaction in the mass spectrometer. With the intensities available from the isotope separator, collisions of less abundant species in an ionic spectrum can be studied in detail. Absolute total cross sections for ion-neutral interchange reactions of low velocity ions are presented as well as charge transfer processes at high kinetic energies to demonstrate the applicability of this experimental arrangement in the study of atomic and molecular collisions. (auth)

24269 CRITICALLY DAMPED OSCILLATORY LINEAR INDUCTION ENGINE FOR DRIVING A BUBBLE CHAMBER VALVE. Coyne, Donald G.; Mullins, Joe H. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Rev. Sci. Instrum., 38: 681-5(May 1967). (CALT-68-105).

For the purpose of driving a large, fast, bubble chamber expansion valve, an engine was developed for the linear transport of a mass through a sinusoid motion for one-half cycle. The unique features are that moving parts are completely inductively coupled with the power source with no physical connections, and that a damper system has been devised giving a critical damping characteristic. Basic equations are given, and the computer solution for a 4.6 kg mass, 3 cm amplitude, and 33 cps frequency is described and compared to actual performance. Scaling laws are quoted. (auth)

24270 TRANSISTORIZED CURRENT STABILIZER FOR X-RAY TUBES WITH DIRECTLY HEATED CATHODES. Yee, Kenneth W.; Deslattes, Richard D. (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instrum., 38: 637-8(May 1967).

An instrument is described which stabilizes the emission current in x-ray tubes with directly heated cathodes. Transistors are used in the amplifier and loading circuits. Emission currents from 20 to 1000 mA are maintained constant to within 0.1% for periods of at least a half hour. (auth)

24271 NEW CONICAL CAMERA FOR SINGLE-CRYSTAL ORIENTATION BY MEANS OF X RAYS. Arguello, C. (Univ., Sao Paulo, Brazil). Contract ONR N00014-66-C0097. Rev. Sci. Instrum., 38: 598-600(May 1967).

A modification of the back reflection Laue camera in which the film is placed on a conical surface, thereby providing a direct stereographic projection of the crystal without the use of nets or the measurement of angles is described. A larger number of reflections is also obtained for this camera as compared with the flat camera. A quantitative discussion of the geometry of the diffraction patterns obtainable with this camera is presented. (auth)

24272 CHARGED PARTICLE TRANSMISSION THROUGH SPHERICAL PLATE ELECTROSTATIC ANALYZERS. Paolini, F. R.; Theodoridis, G. C. (American Science and Engineering, Inc., Cambridge, Mass.). Contract AF 19(628)-5712. Rev. Sci. Instrum., 38: 579-88(May 1967).

The transmission characteristics of spherical plate electrostatic analyzers for external sources are studied. Transmission as a function of particle point of incidence, angle of incidence, and kinetic energy, and of analyzer plate geometry (central angle and radii of curvature) and plate potentials, is determined analytically and graphically. Our method (which assumes that the ratio of plate spacing to mean radius is small) uses derived relationships between these parameters and the position of the center of the particle's trajectory, which trajectory is approximated by a circular arc. For a fine incident beam of particles, angular resolution at mean transmitted energy and energy resolution at normal incidence are independent of the point of incidence; the angular resolution is moreover a constant and the energy resolution varies linearly with the mean energy. The area of energy-angle transmission diagrams is likewise independent of point of incidence. Energy and angle response functions for diffuse beams of particles are derived semi-empirically. The energy response function (integrated over angle) has the same FWHM as the function for a fine beam incident normally. The angle response function (integrated over energy) has the same FWHM as the function for a fine beam at appropriate fixed energy. Theoretical results for fine beams are compared with experiment and agree well. A practical instrument, specifically for satellite use but suitable for the laboratory, is also described. (auth)

24273 AUTOMATIC PHOTOELASTIMETER. Costa Ribeiro, S. (Escola de Engenharia, Sao Carlos, Brazil). Rev. Sci. Instrum., 38: 705-7(May 1967).

An automatic photoelastimeter for rapid and precise quantitative measurements of the strain profile in alkali crystals and other transparent materials in order to study radiation damage in solids is described. (B.G.D.)

24274 LITR INSTRUMENTATION MODIFICATIONS (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1568).

19 drawings.

The reactor control and instrumentation systems for the LITR were modernized and upgraded. The process system hardware was completely replaced with modern and versatile all-electronic equipment. The nuclear system assemblies were rebuilt and improved so that they would be interchangeable directly, or following minor modification, with comparable Oak Ridge Research Reactor (ORR) assemblies. New assemblies and components are standard in current design practices. (For details see TID-4100 Suppl. 40). (F.S.)

24275 TECHNICAL CONFERENCE ON PREPARATION AND PROPERTIES OF ELECTRONIC MATERIALS FOR THE CONTROL OF RADIATIVE PROCESSES, BOSTON, MASS., AUG. 29–31, 1966. Trans. Met. Soc. AIME, 239: 289-424(Mar. 1967). (CONF-660831).

The conference included 27 papers on the preparation and properties of materials used as photodetectors, light emitters, microwave emitters, or electro-optic modulators. An abstract was prepared for one paper. (C.E.S.)

For an abstract of the individual paper see: 24201.

Radiation Effects on Instruments and Instrument Components

24276 (N-67-11722) EFFECTS ON SILVER AND ZINC BATTERY ELECTRODES V. Interim Report, April–July 1966. Nicholson, M. M.; Recht, H. L.; Kelchner, R. E. (Atomics International, Canoga Park, Calif.). Oct. 14, 1966. Contracts NAS7-100; JPL-951109. 26p. (NASA-CR-79489; AI-66-186). CFSTI $3.00 cy, $0.65 mn.

The investigation of gamma radiation effects on silver electrodes at 60% and 30% states of charge was continued. Net capacity increases averaging 5% have been observed during irradiations at the 60% level with a total dose of 7×10^7 RADS (H_2O). At 30% net losses of 4 and 15% were found in the two runs, respectively. It appears that the losses at 30% may be significant, while the changes at 60% are essentially within the uncertainty of the measurements. Hydrogen was again evolved during the irradiation of silver–cadmium cells. In one run two silver electrodes were cycled one against the other in the absence of cadmium. Hydrogen and oxygen were then produced in a mole ratio of 1.7:1. Work with zinc electrodes was concentrated on a reproducible procedure for determination of discharge capacity. This was partially accomplished by the use of cellophane-wrapped zinc electrodes in starved-electrolyte cells. With that construction, the capacity will offer at least a semiquantitative criterion for the evaluation of radiation effects. (auth)

24277 (N-67-11732) EFFECTS OF HIGH-ENERGY PROTONS ON SELECTED CELLS. Final Report, June 1966–August 1966. Nicholson, M. M.; Recht, H. L.; Kelchner, R. E. (Atomics International, Canoga Park, Calif.). Aug. 1966. Contracts NAS7-100; JPL-951648. 26p. (NASA-CR-79535; AI-66-149). CFSTI $3.00 cy, $0.65 mn.

Experimental silver–cadmium and nickel–cadmium cells containing commercial battery electrodes and aqueous potassium hydroxide electrolytes were exposed to 60 and 137 MeV protons. Total integrated proton fluxes were twice the maximum values anticipated from solar flare activity during travel to Venus in 1967 to 69. Irradiated and control cells were examined for gas evolution, loss of electrode materials, and changes in discharge capacity. With the exception of low-level, rapidly-decaying radioactivity, no proton effects were detectable. (auth)

24278 (RT-ING-(66)-14) BEHAVIOUR OF IRRADIATED THERMOCOUPLES: EXPERIMENTAL INVESTIGATIONS. Bianchi, G.; Lupoli, P., Moretti, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1966. 23p. Dep.

Two experiments that were used to study radiation effects on thermocouples are described. In the first experiment, calibration was performed during irradiation at various power levels and at reactor shutdown, by means of an ideal reference thermometer placed within the rig. In the second experiment calibration was performed after irradiation in a hot facility. The materials used were Cr–Al, Fe, and Cr. The results demonstrated that no appreciable drift arises after an integrated neutron flux up to 10^{20} nvt in the thermoelectric characteristic of Cr–Al thermocouples, used in the temperature range up to 600°C. (P.C.H.)

24279 THERMAL NEUTRON TRANSMUTATION EFFECTS ON W/W-26Re THERMOCOUPLES. Wood, Van E. (Battelle Memorial Inst., Columbus, Ohio). J. Appl. Phys., 38: 1756-8 (Mar. 15, 1967).

A theoretical estimate is made of the change in output voltage to be expected when a W/W-26Re thermocouple is exposed to thermal neutrons, causing some of the rhenium to be transmuted to osmium. The estimated drift may be fairly large: as much as 9.1% when ⅓% of the rhenium atoms are transmuted for a couple measuring a nominal temperature of 1800°C. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 23905, 24437, 24483, and 24557.

24280 (AWRE-O-15/67) ACTINIDE INTERACTIONS WITH BLOOD SERUM PROTEINS. Boocock, G.; Popplewell, D. S. (Atomic Weapons Research Establishment, Aldermaston (England)). Feb. 1967. 25p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s. 6d.

Studies of the distribution of plutonium, americium, and curium in human blood serum proteins have shown the high stability of the plutonium-transferrin complex relative to the unidentified protein complexes of americium and curium. It is suggested that the binding sites of transferrin for plutonium have similarities with the binding sites for iron. A second plutonium–binding protein was also observed in human blood serum. (auth)

24281 (BMwF-FBK-66-25) DIE SUPPRESSION DER JOD-132-AUFNAHME DER SCHILDDRUESE DURCH L-TRIJOD-THYRONIN. (The Effect of L-Triiodothyronine on Thyroid ^{132}I Uptake). Leistner, G. H. (Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany)). July 1966. 27p. (In German). Dep. mn. DM 5,40.

The effect of 300 μg of triiodothyronine on thyroid uptake of radioiodine was investigated in 656 patients. In 93.8% of euthyroid and 1.8% of hyperthyroid patients a suppression of uptake exceeding 22% was observed. Based on these findings, a simple test for investigating thyroid function with iodine-132 is described. The presence of a multinodular thyroid enlargement interferes with the test results, as does the previous administration of thyro-active substances. An explanation for the rather frequently observed failure of suppression in large goiters after previous medical treatment is discussed. (auth)

24282 (BMwF-FBK-66-47) DER EINFLUSS EINER FRAKTIONIERTEN ROENTGENBESTRAHLUNG AUF DEN DPN-GEHALT SOLIDER TUMOREN UND DER WIRTSLEBER. (The Influence of a Fractionated X-Irradiation on the DPN-Content of Solid Tumors and the Host Liver). Hoelzel, F.; Trobisch, H. (Hamburg Univ., Eppendorf (West Germany). Frauenklinik). Dec. 1966. 10p. (In German). Dep.

No changes of the DPN-content of solid Ehrlich carcinoma were found after a fractionated x irradiation with 2000 R. The DPN-content of the liver of the tumor-bearing animals was reduced. It could be elevated by application of nicotine amide. An increase of the liver-DPN at the same degree was observed in the animals whose tumors had been irradiated. (auth)

24283 (BNWL-SA-1004) TIDAL VOLUME AIR MONITOR. Wilbur, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 5, 1967. Contract AT(45-1)-1830. 5p. (CONF-670514-1). Dep. CFSTI.

From 5th National Biomedical Sciences Instrumentation Symposium, Albuquerque, N. Mex.

Deposition studies of inhaled radionuclides in canines require an accounting of the amount of air respired by the test subject. With tidal volume information and the known concentration of the radionuclide aerosol, approximate levels of deposition can be calculated. Also desirable is continuous monitoring of respiration parameters during exposure to note changes in breathing patterns to determine deposition effectiveness. This paper describes a monitor which records the total number of respirations, the tidal volume per inhalation, and the tidal volume per exposure. Information is displayed on both digital and analog recorders. By selecting suitable transducers, this system can be used on a variety of test subjects subjected to many related biological tests. (auth)

24284 (CONF-631008, pp 82-91) PRENATAL IRRADIATION AND CNS PHYSIOLOGY AND BIOCHEMISTRY. Hicks, S. P. (Michigan Univ., Ann Arbor).

Various aspects of biochemical and physiological effects of prenatal irradiation on the central nervous system are reviewed. Studies on radioinduced brain malformations, abnormal electroencephalograms following prenatal irradiation, and other studies are reviewed. (H.L.W.)

24285 (CONF-631008, pp 92-110) PRENATAL IRRADIATION AND POSTNATAL BEHAVIOR. Sharp, J. C. (Walter Reed Army Inst. of Research, Washington, D. C.).

The following aspects of prenatal radiation effects on postnatal behavior are reviewed: cognitive functions or learning; motor processes; sensory processes; motivation; sex differences. (H.L.W.)

24286 (COO-119-235) RESEARCH IN RADIOBIOLOGY. SEMI-ANNUAL REPORT OF PROGRESS IN THE INTERNAL IRRADIATION PROGRAM. Dougherty, Thomas F. (Utah Univ., Salt Lake City. Radiobiology Div.). Sept. 30, 1966. Contract AT(11-1)-119. 144p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts have been prepared for the six parts of this report. (C.H.)

For abstracts of individual sections see: 24287–24291 and 24542.

24287 (COO-119-235, pp 4-70) [TOXICITY OF RADIONUCLIDES]. (Utah Univ., Salt Lake City. Radiobiology Div.).

Data are summarized on the pathological effects of injected ^{226}Ra, ^{228}Ra, ^{239}Pu, ^{90}Sr, and ^{228}Th in dogs. (C.H.)

24288 (COO-119-235, pp 76-95) REACTION OF PuIV WITH THE IRON TRANSPORT SYSTEM IN HUMAN BLOOD SERUM. Stover, Betsy J.; Bruenger, F. W.; Stevens, W. (Utah Univ., Salt Lake City. Radiobiology Div.).

When human blood serum that has been tagged in vitro with monomeric PuIV is subjected to gel filtration most of the PuIV is found in two molecular weight ranges, that of the low molecular weight serum proteins and that of small molecules and ions. The distribution of PuIV between the two peaks is variable. In addition a small amount is eluted in the highest molecular weight fraction. By a combination of gel filtration, ion exchange, and electrophoresis the protein in the low molecular weight group that binds PuIV has been isolated and shown to be transferrin, the protein that transports iron. PuIV appears to be bound at the iron binding sites, and the reaction between PuIV and transferrin has been shown to be reversible. The stability constant of the complex is high but less than that of the very stable iron-transferrin complex. The variation in distribution of PuIV between transferrin and the low molecular weight region thus is related to the variation in the amount of iron bound by the transferrin. (auth)

24289 (COO-119-235, pp 96-106) DEVICE FOR MULTIAUTORADIOGRAM EXPOSURE STANDARDIZATION. Taysum, David H.; Stain, Richard; Jee, Webster S. S.; Atherton, David R. (Utah Univ., Salt Lake City. Radiobiology Div.).

An instrument for producing standard ^{90}Sr exposures on 10 autoradiograms simultaneously is described. Acceptable film densities are obtained in about 2 hours. Dose rate at the exposing surface of each of the 10 exposure sources is 7.5 rad/hour but radiation of any kind measured at any point on the external surface of the instrument is less than 0.2 m R/hour. Applications in studies on the distribution of ^{90}Sr in tissues of dogs are discussed. (C.H.)

24290 (COO-119-235, pp 107-36) POTASSIUM STUDIES IN HUMANS. Wagner, W. W.; Mays, C. W.; Lloyd, R. D.; Pendleton, R. C.; Zundel, W. S. (Utah Univ., Salt Lake City. Radiobiology Div.).

Body potassium in grams was evaluated in man by total body counting the 1.46 MeV γ rays from ^{40}K. Two potassium parameters were computed; the conventional potassium concentration [body potassium/body mass], and a new quantity which is called the muscle index. Potassium concentration tends to decrease with advancing age, whereas muscle index tends to remain fairly constant for healthy people in the age range studied, which included males aged 5 to 66 yr and females aged 5 to 55 yr. (53 references.) (C.H.)

24291 (COO-119-235, pp 137-42) SHORT HALF-TIMES OF ^{137}Cs IN PREGNANT WOMEN. Mays, Charles W.; Zundel, Wayne S.; Lloyd, Ray D.; Wagner, William W.; Pendleton, Robert C. (Utah Univ., Salt Lake City. Radiobiology Div.).

The biological half-time of environmental ^{137}Cs was evaluated in women. It was 49 ± 16 days in 24 pregnant women, in contrast to 84 ± 27 days in 15 non-pregnant women. This average shortening to 58% of the control half-time was highly significant but the exact mechanism still remains an enigma. (auth)

24292 (FOA-04-4321-4623) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. IV. INFLUENCE OF EXCHANGEABLE AND NON-EXCHANGEABLE CALCIUM IN SOIL ON THE ABSORPTION OF ^{137}Cs BY RED CLOVER IN POT EXPERIMENTS WITH 178 SWEDISH SOILS. Fredriksson, L. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). July 1963. 25p. Dep.

The influence of lime and potassium status in soil on plant absorption of ^{137}Cs is studied in pot experiments with 178 representative Swedish soils. With the aid of multiple regression analysis functional relations between the factors in question are found. It is suggested that the relations found could be made use of for quantitative assessments of plant absorption of ^{137}Cs through root uptake. (auth)

24293 (LA-DC-8682) EVOLUTION OF ENZYME LOCATIONAL SPECIFICITY: MODELS IN MICROBIAL GENETICS. Munkres, Kenneth D. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 37p. (CONF-670315-1). Dep. CFSTI.

From Colloquium on Biochemical Evolution, Properties, and Structure of Homologous Enzymes, Paris, France.

Two types of cryptic biochemical mutations in Neurospora are described. In the first type the enzyme binds in a distorted conformation at the appropriate site; in the second type a protein at the intracellular receptor site is genetically altered in association with the given enzyme. The first type is illustrated by the genetics of mitochondrial malate dehydrogenase; the second type involves the genetics of the receptor site protein, mitochondrial structural protein. Both support the hypothesis that locational specificity is an intrinsic and genetically determined property of proteins. It is concluded that the genetically determined structural integrity of both the enzyme and the receptor protein is essential for appropriate function of the enzyme in the complex. Other gene-enzyme systems in microorganisms are discussed in terms of locational specificity. (H.L.W.)

24294 (NIRS-5, pp 19-25) BIOCHEMISTRY AND BIOPHYSICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported on the following studies: the stability of DNA in Escherichia coli B/r and B_{s-1} irradiated with ultraviolet light; modification of the amount of radiation-induced free radicals by post-irradiation treatments in Artemia eggs; primary effect of ionizing radiation on mitochondria in vitro; effects of γ irradiation on respiration and glycolysis of Ehrlich Ascites tumor cells; loss of nucleotide bases from thymocytes irradiated in vitro; ultraviolet reactivation of bacteriophage ϕR containing a single-stranded DNA as a genetic element; protection by substrate analogues from uv-damage of bovine pancreatic ribonuclease; bioconversion of steroids in immature rat testes in vitro; on side chain cleavage of 17-α-hydroxyprogesterone by rat testicular enzyme; and glycolytic intermediates of reticulocytes during maturation. (H.L.W.)

24295 (NYO-3364-32) THE ^{137}Cs BODY BURDEN OF CIVILIAN PILOTS. Hannisdahl, Birger (Scandinavian Airlines System (Norway)); Stroemme, Aksel (Statens Radiologisk-Fysiske Laboratorium, Oslo (Norway)). [nd.] Contract AT (30-1)-3364. 4p. (CONF-661120-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Meeting on Aerospace Medicine, Sydney, Australia.

During the last few years there has been considerable interest in the study of the body burden of radioactive contaminants of aircraft personnel. So far the measurements have mainly been carried out on military personnel with the consequence that little is known about the radioactive body burden of civilian pilots. The radioisotopes of interest are those which originate from nuclear weapons tests in the atmosphere. Of these the easiest to study in the human body are the gamma-emitters of which the two most important are ^{131}I and ^{137}Cs. Because ^{137}Cs has a relatively long half-life it is more suitable for studies over a long period of time than ^{131}I that has a short half-life. Therefore, during 1964, 1965, and 1966 several examinations of Norwegian pilots were performed. The pilots were measured in steel chambers with the background radiation reduced to 1% of the level outside the chamber. It was concluded that ^{137}Cs body burden of the pilots was about the same as the body burdens of other male residents of Oslo, and much lower than the body burdens of some of other groups of the Norwegian population. It was also concluded that flights at less than 30,000 feet were of little risk as far as radioactive fallout was concerned. (S.M.H.)

24296 (ORAU-104) TURNOVER COMPARTMENTALIZATION: A STATISTICAL TRACER THEORY FOR ANALYSIS OF WHOLE-SYSTEM RETENTION DATA. Bergner, Per-Erik E. (Oak Ridge Associated Universities, Tenn.). May 1967. Contract AT-40-1-GEN-33. 36p. Dep. CFSTI.

Physical problems related to the application of tracer methods in physiology are discussed. A tracer dynamics theory was constructed for metabolism studies using radioactive tracer methods. The metabolic pool is considered to be divided into compartments, and mathematical equations are presented to explain the theory for analysis of whole-system retention data. (H.L.W.)

24297 (ORO-2401-9) UTILIZATION OF A LOW-LEVEL WHOLE BODY COUNTING FACILITY IN THE MEASUREMENT OF ELECTROLYTE COMPOSITION AND METABOLISM IN MAN, Comprehensive Report, 1964-1966. (Vanderbilt Univ., Nashville, Tenn. Dept. of Medicine). Oct. 27, 1966. Contract AT(40-1)-2401. 29p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Data are given on methodology of whole body counter modifications, calibration of scanning bed geometry, and quantitative analysis of radionuclide distribution in man by computer methods. Applications of electrolytes and radionuclides included: ^{40}K, ^{137}Cs, magnesium and potassium interrelationships, zinc studies, manganese studies, electrolyte and body fluid metabolism dosimetry of medically important radionuclides is discussed. Endocrine studies consisted of: renin-angiotensin in hypertension, calcium metabolism and bone density, thyroid studies. Hematological studies were made of iron turnover. A list of 75 references was cited. (S.M.H.)

24298 (PAEC(A)-IN-655) RADIOISOTOPES IN SOILS AND NUTRITION. (Philippine Atomic Energy Commission, Manila). May 1966. 114p. Dep. mn.

Six-hundred and fifty-six references are presented to literature on the distribution of radioisotopes in the soil and the effects of soil radioisotopes on plant nutrition. (C.H.)

24299 SENSITIVITY TO 1-METHYLNAPHTHALENE OF WHOLE-BODY IRRADIATED RATS. Scoppa, P. (EURATOM, Ispra, Italy). Z. Naturforsch., 21b: 1054-6(Nov. 1966).

Whole-body irradiation of the rat produces a decrease of the urinary excretion of glucuronides originating from the detoxication of 1-methylnaphthalene; in apparent contrast with the conclusion which could be drawn from this finding the rat exposed to x irradiation has a higher resistance to the toxic action of the hydrocarbon. The results obtained show that the decreased sensitivity to 1-methylnaphthalene is due to the response of the gastrointestinal system of the rat to radiation: in the animals exposed to 400 R of x rays before the administration of 1-methylnaphthalene, the absorption of the hydrocarbon is strongly delayed and takes place at a much slower rate. These changes may partially explain the so-called "paradoxical effect" of radiation on the sensitivity to certain toxic compounds administered to the rat by oral route. (auth)

24300 PEROXIDASE ISOZYMES IN BARLEY LEAVES FROM IRRADIATED SEEDS. Giacomelli, M. (CNEN, Rome). Nature, 213: 1265-6(Mar. 25, 1967).

It is known that ionizing radiation causes an increase in peroxidase activity in plants, but so far the mechanism is unexplained. This communication reports the presence of new peroxidase bands in the zymograms of barley leaves from irradiated seeds. Experimental techniques are described, involving starch gel electrophoresis. The zymogram of peroxidase from the irradiated samples showed five isozymes at the cathode and four at the anode, whilst unirradiated samples showed only three isozymes at the cathode and two at the anode. The staining intensity of all the bands for the irradiated samples was increased, as compared with controls, indicating a greater enzyme activity. It is concluded that seed irradiation causes deep alteration of the system which regulates the biosynthetic pattern, causing a differentiation of forms of the peroxidase isozymes, the biological significance of which remains to be established. (INIS-UK)

24301 EFFECT OF SOME INHIBITORS ON THE FORMATION OF THE DEPROTEINIZATION FACTOR IN SMALLPOX VACCINE VIRUS. Zhdanov, V. M.; Peterson, O. P.; Kozlova, I. A.; Mel'nikova, L. A.; Balandin, I. G. (Inst. of Virology, Moscow). Dokl. Akad. Nauk SSSR, 171: 471-2(Nov. 11, 1966). (In Russian).

Certain inhibitors (e.g., histone, actinomycin D, interferon) suppress the multiplication of smallpox vaccine virus in tissue culture and alter the metabolic processes in the cells, but their precise mode of action is unknown. The effects of histone and x rays on the synthesis of this virus were studied. They found that cell extracts treated with histone and then infected with the smallpox vaccine virus did not cause reactivation of the heated virus, regardless of the dilution. Extracts of irradiated cells, on the other hand, did reactivate the heated virus, but in low dilutions (1 : 1 : 2), whereas the control extracts obtained from infected cells reactivated the virus only in 1 : 8 dilutions and higher. It is concluded that histone blocks the formation of the deproteinization factor. Its action involves production of the histone-virus DNA complex and exclusion of the latter from multiplication of the virus. Ionizing radiation acts mainly on the enzyme systems responsible for the synthesis of virus DNA, which, in turn, affects the degree of synthesis of the deproteinization factor. Thus, irradiation seems to inhibit virus multiplication by acting on the genetic function of the cell, while histone suppresses the transcription function of virus DNA. (CFSTI)

24302 HYDRODISULFIDE GROUPS IN UNTREATED AND IRRADIATED WOOL KERATIN. Sweetman, B. J. (CSIRO, Parkville, Australia). Text. Res. J., 36: 718-24(Aug. 1966).

Evidence is presented which suggests that the lead acetate test when carried out on untreated wool is dependent on the presence of hydrodisulfide (-SSH) groups rather than cystine residues. The hydrodisulfide group is probably also formed during uv irradiation (2537 Å) of wool via C-S fission of cystine residues. The analytical data indicated that the high uptake of methyl mercuric iodide by irradiated wool is due neither to intermediate oxidation products of the cystine residues nor to thiol groups. Sulfur content of irradiated wool was unaltered by irradiation, indicating that all products of the degradation of cystine remain in the fiber. One of these products is responsible for the intensely positive lead acetate test given by irradiated wool. This product is degraded by boiling water, liberating hydrogen sulfide, and is apparently readily oxidized. These properties are consistent with those expected for the hydrodisulfide group. (TSS)

24303 CESIUM UPTAKE FROM DILUTE SOLUTIONS BY YOUNG WHEAT SEEDLINGS AS AFFECTED BY SELECTED CATIONS. Jackson, W. A.; Lugo, Hector M.; Craig, Doris (North Carolina State Coll., Raleigh). Plant Soil, 24: 33-53 (Feb. 1966).

Experiments were conducted with young wheat seedlings to determine the effects of selected cations on Cs uptake by roots and subsequent transport to shoots. The experiments were conducted in dilute, slowly stirred solutions. Uptake by roots was reduced by prior K treatment and simultaneous presence of K, Rb, and NH_4. Addition of Ca at pH 4 increased Cs-uptake by roots. Transport to shoots was reduced by Ca at pH 6 by NH_4, and by K and Rb when the K content of the tissue was high. When the K content of the tissue was low, little Cs transport occurred and solution concentrations of K up to 0.01 me per liter increased Cs transport. The data suggest that separate processes were involved in Cs uptake and transport with competition existing between the two processes for the entering Cs. Ammonium ions inhibited both uptake and transport to about the same extent whereas K inhibited uptake more than transport. (auth)

24304 INACTIVATION OF PEPSIN BY X RADIATION AND ITS DEPENDENCE ON WATER CONTENT IN CONNECTION WITH THE ORIGIN OF LONG-LIVED RADICALS. Sommermeyer, K.; Schnepel, G. H. (Univ., Freiburg i. B.). Biophysik, 3: 213-23(1966). (In German).

Dry and moist pepsin up to a water content of 60% was irradiated with x rays or electrons and the dependence of both the radical numbers and the degree of inactivation on the moisture and the storage time was measured. A percentage of the radicals, increasing with the water content, was discharged by the water immediately after their formation (in a time <3 min.). In contrast the inactivation is completely independent of the water content. In storage of dry enzyme in air for more than 14 days, the rate of inactivation remains constant, although the ESR spectrum decays. The results were explained by the assumption that the same reactions, which lead in the aging of dry or moist pepsin to the extinction of the radicals, occur in the pepsin in solution in water when it is irradiated dry and dissolved in water immediately after irradiation. (tr-auth)

24305 ALKALINE TRANSFORMATIONS OF THE PHOTOHYDRATES OF SOME 2,4-DIKETOPYRIMIDINES AND THEIR GLYCOSIDES. Fikus, Magdalena; Shugar, D. (State Inst. of Hygiene, Warsaw). Acta Biochim. Pol., 13: 39-56(1966).

Ultraviolet irradiation of uracil glycosides in aqueous medium leads to the nucleophilic addition of water to the 5,6 double bond of the pyrimidine ring. In aqueous frozen medium the principal reaction was the formation of a photodimer in which the 5,6 bonds of two molecules combined to form a cyclobutane ring. In aqueous alkaline medium the photohydrate of 1-methyluracil underwent direct base-catalysed dehydration to regenerate, quantitatively, 1-methyluracil. In aqueous ammoniacal medium the photohydrate of 1,6-dimethyluracil underwent ring opening at the 1,6 bond; this was followed by dehydration and finally ring closure to quantitatively reform 1,6-dimethyluracil. The photohydrate of uridine (and many other uracil glycosides) undergoes two simultaneous, competing reactions: direct base-catalysed dehydration and ring opening at the 1,6 bond that is followed by dehydration and ring closure. These reactions lead to the quantitative regeneration of uridine. In a medium made alkaline with NaOH or KOH, a third reaction intervened; the extent of the reaction was dependent on the pH and involved opening of the ring at the 3,4 bond. This reaction did not lead to regeneration of uridine. However, addition of an excess of ammonia after the addition of NaOH or KOH abolished the effect of the latter and led to quantitative regeneration of uridine. In alkaline methanolic medium the photohydrates of 1,6-dimethyluracil, and of the uracil glycosides, underwent only one type of transformation: ring opening at the 1,6 bond, dehydration of the open chain compound, and ring closure to regenerate the parent compound. The presence of trace amounts of water were necessary for this reaction sequence. The difference in behavior in alkaline medium between the photohydrates of 1-methyluracil and the uracil glycosides appeared to be due to some influence of the glycosidic linkage. The kinetics and activation energies for some of the reactions were measured and isotope effects in heavy water were also examined. The significance of these results for quantitative reversal of uracil hydration in uv-irradiated polyuridylic acid and RNA is discussed. (BBB)

24306 ANTIMICROBIAL IMMUNITY TRANSMITTED TO RATS BY HOMOLOGOUS BONE MARROW GRAFTS. Apateanu, V. (Centrul de Hematologie, Bucharest). Rev. Roum. Med. Interne, 3: 31-4(1966). (In French).

It was shown that bone marrow cells from immunized animals when transplanted in homologous, lethally irradiated hosts can continue to produce specific antibodies. Wistar rats were used as donors and recipients (irradiated with 700 R of x rays) to demonstrate the transfer of immunogenic activity that persisted for about 30 days in the irradiated hosts. The donor rats received 3 injections of Salmonella typhi B cells before supplying bone marrow cells to be injected in the recipients. Evidence of agglutinin production in the recipients was detectable by the 12th day after bone marrow transplantation and serum titers of 1:64 were attained by the 30th day. The titers then dropped rapidly, apparently with the elimination of the grafted cells. (BBB)

24307 INDUCTION OF FOUR POSSIBLE DIMERS OF 1,3-DIMETHYLURACIL BY UV IRRADIATION OF 1,3-DIMETHYLURACIL IN AN ICE-MATRIX. Fuerst, Gerhard; Fahr, Egon; Wieser, Heinz (Univ., Wuerzburg, Ger.). Z. Naturforsch., 22b: 354(Mar. 1967). (In German).

A concentrated aqueous solution of 1,3-dimethyluracil was frozen and irradiated with uv. The irradiation products were separated by thin-layer chromatography. Four dimethyluracil dimers A, B, C, and D were obtained in the ratio 1:4:10:1.5. The B, C, and D isomers are thermally stable. Dimer A decomposes even at room temperature so that it could not be obtained in pure form. The melting point and the R_f values of the four dimers were given. (J.S.R.)

24308 ON THE USE OF THYMIDINE-^{3}H IN TISSUE CULTURE. Powsner, E. (Wayne State Univ., Detroit. Radioisotope Service Veterans Administration Hospital, Dearborn, Mich.). Int. J. Appl. Radiat. Isotop., 18: 206-7(Mar. 1967).

The use of thymidine-^{3}H in vitro to measure DNA synthesis requires a knowledge of its persistence. In vivo injection is known to be followed by rapid degradation, but use of this material in vitro has been assumed by many workers to provide a continuously available substrate for DNA labeling. It was found that the validity of this assumption depends to a great extent on the source of the cells. The short life of thymidine in human cell cultures is emphasized, but it is pointed out that the rate of loss varies at least six-fold in human cultures and more widely between species. Persistence coincides with the ability of the culture medium to label cell nuclei. Some experimental work is described. Results showed that thymidine was lost exponentially from human cell cultures for about 6 hours and then more slowly. Cultures prepared from rat or rabbit bone marrow showed in general a maximum thymidine loss of about 30% in 24 hours, although some cultures showed no loss in this time. There was no apparent evidence for an inhibitor or metabolic competitor. (UK)

24309 LIPID OXIDATION IN PRE-COOKED BEEF PRESERVED BY REFRIGERATION, FREEZING, AND IRRADIATION. Chang, Pi-Yu; Younathan, Margaret T.; Watts, Betty M. (Florida State Univ., Tallahassee). Food Technol., 15: 168-71(Mar. 1961).

Oxidation of lipids in the lean tissue of roast beef slices preserved by refrigeration, freezing, or irradiation was followed by the thiobarbituric acid (TBA) test and organoleptic evaluation. In experiments designed to determine whether antioxidant dips (solutions of tripolyphosphate or ascorbate) that stopped lipid oxidation in refrigerated and frozen beef would also benefit irradiated roast beef slices, sealed cans of beef received 4.8-Mrad γ irradiation. The lower TBA numbers of the irradiated samples stored at room temperature, as compared to those in the freezer, were associated with development of pink color at the higher storage temperature, whereas the frozen samples remained gray or greenish gray. Odor ratings made on samples at 4 storage intervals ranging from 0 to 210 days of storage, revealed that unirradiated samples dipped in antioxidant were much fresher in odor than the controls. Odor scores for the irradiated samples, in contrast, were not improved by antioxidant dips or by freezer vs room-temperature storage. Cover solutions, both with and without antioxidants, gave lower TBA values than the corresponding dip techniques in all freezer-

stored samples. With the irradiated samples, as in the previous experiment, there was little difference in any of the samples after room-temperature storage, all TBA numbers were low. The cover solutions improved the odor scores of the frozen irradiated samples, but not of those stored at room temperature. All unirradiated samples were the typical gray-brown of cooked meat. In all covered irradiated samples, the color appeared as bright pink at all times after irradiation. Packaging in oxygen resulted in greater lipid oxidation in both frozen and irradiated samples. The use of antioxidant dips completely protected the frozen samples, even under these extreme conditions, but were much less effective than evacuation for the irradiated samples. Exclusion of oxygen in the irradiated samples resulted in a bright-pink meat, whereas oxygen caused destruction of pigment, with a resulting gray color. It was concluded that lipid oxidation is not an important factor in irradiated beef stored at room temperature, and that antioxidant combinations of ascorbate and polyphosphate, used either as dips or as cover solutions, eliminate lipid oxidation and greatly improve the odor of refrigerated and frozen beef, but do not benefit irradiated beef. (BBB)

24310 SOME UNSOLVED PROBLEMS ON PHOTOREACTIVATION: CONCLUDING REMARKS. Giese, A. C. (Stanford Univ., Calif.). pp 320-2 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.

Two aspects of photoreactivation of uv effects are discussed: why some cytoplasmic effects are subject to photoreversal while others are not, and second, why uv damage to some species of organisms is not subject to photoreversal. Effects of uv upon the cell nucleus of a given organism are subject to photoreactivation while effects of uv upon cytoplasm may not be. The discrepancy between photoreversibility and nonphotoreversibility of various cytoplasmic effects may be resolvable on the basis of action of uv at many loci in the cell, action on different loci being responsible for different effects. The action spectrum for inhibition of chloroplast development in Euglena implicates nucleoproteins. Consequently in this case, the effect of uv on cytoplasm may be mediated by reactions much like those following irradiation of the nuclei, and like those in the nuclei, photoreversible. Similar action spectra and mechanisms for other photoreversible effects of uv upon the cytoplasm may be postulated. The fact that some uv-treated cells have shown no photoreactivation is discussed. Many bacteria, among them some bacilli (Streptococcus faecalis and S. lactis, Azotobacter vinelandii, Hemophilus influenzae, and Diplococcus pneumoniae) show no photoreactivation from uv inhibition of growth. Among animal cells, retardation of division of Blepharisma undulans by uv and change in discharge from a pressure receptor of the crayfish produced by uv show no photoreversal. Drastic action of uv is not subject to photoreversal. The failure of photoreactivation in H. influenzae is the consequence of lack of the appropriate photoenzyme in Hemophilus; not, however, of the other constituents, since photoreactivation of Hemophilus transformation is readily achieved with extracts of Escherichia coli or yeast containing the photoenzyme. Failure to obtain photoreactivation in some yeast mutants may result from lack of appropriate hereditary determinants. The retardation of division of Blepharisma undulans by uv is also discussed. (BBB)

24311 EFFECTS OF IONIZING RADIATION ON THE METABOLISM OF SERUM PROTEINS IN RABBITS. Paulov, Stefan (Univ. Komenskeho, Bratislava). Biol. Prace, 7: 1-56(1961). (In German).

Changes observed in the metabolism of serum proteins of rabbits exposed to ^{60}Co radiation at doses of 200 to 1100 R were studied. There was a general diminution of serum proteins in the post irradiation interval, the amount of this decrease as well as the return to normal values being directly proportional to the dose used. Simultaneously with the hypoproteinemia, a negative nitrogen balance was observed. The serum of irradiated rabbits showed characteristic changes in the absorption spectrum of the uv region. The serum was strongly opalescent when taken from rabbits which died a short time after irradiation. In the postirradiation phase a diminution of albumin/globulin ratio was observed as well as an increase of α- and β-globulins, with a diminution of albumin and γ-globulins. With greater radiation doses these phenomena were more pronounced and the time necessary for a return to normal increased. After an intravenous injection of methionine-^{35}S in normal rabbits, there was a rapid drop of sp act., then a stabilization of activity of ^{35}S within 1 to 2 hr, followed by a moderate increase of ^{35}S activity 6 to 7 hr after injection of the amino acid. More methionine was incorporated into globulins than into albumin in nonirradiated control rabbits. The amino acid incorporation into particular globulin fractions was proportional to their amount in serum. Max incorporation was observed for all protein components of serum 6 to 8 hr after methionine-^{35}S injection. When methionine-^{35}S was given immediately after irradiation, the irradiated rabbits showed a serum ^{35}S activity stabilized on a higher level in comparison to control rabbits. The increase attained higher values than in control rabbits. In irradiated rabbits α- and β-globulins showed a substantial increase of sp act. when compared with control rabbits. Albumin and γ-globulins showed a relatively low degree of methionine incorporation. In irradiated rabbits after intravenous injection of ^{131}I-labeled serum proteins, there was an accelerated catabolism of albumin and globulins in the postirradiation period. (BBB)

24312 BLOOD SERUM PROTEINS OF RABBITS UNDER NORMAL AND RADIATION CONDITIONS. Paulov, S. (Univ. Komenskeho, Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Zool., 8: 175-220(1963).

Paper electrophoretic studies were made of serum protein fractions in rabbits irradiated with 800-, 1000-, and 1100-R doses of ^{60}Co γ rays. In general, albumin and γ-globulin decreased while α- and β-globulins increased after irradiation. A fraction was found in serum of 1100-R irradiated rabbits not seen in control serum. Catabolism of serum proteins in irradiated rabbits was examined with ^{131}I-labeled proteins and found to be accelerated, with respect to both albumins and globulins. Synthesis of serum proteins, studied by measuring the uptake of ^{35}S-methionine by various fractions, was increased following 800-R irradiation. The increase was greater in globulins than in the albumin fraction, and α- and β-globulins showed the highest incorporation rate of the labeled amino acid in irradiated rabbits. Thus the increase of γ-globulins in irradiated animals occurred because accelerated synthesis overbalanced their augmented catabolic rate. (BBB)

24313 EFFECT OF TRITIUM LABELING OF CORTISOL ON ITS PHYSICAL-CHEMICAL PROPERTIES AND ON ITS METABOLISM IN MAN. Gold, Norman I.; Crigler, John F. Jr. (Children's Hospital Medical Center, Boston). J. Clin. Endocrinol. Metab., 26: 133-42(Feb. 1966).

A study of ring-A saturated 1,2-^{3}H-labeled steroids prepared from their respective Δ^4-3-ketone precursors by isotope dilution procedures using paper chromatography and thin layer chromatography showed in all instances that the tritium-containing compound migrated at a different rate than its unlabeled counterpart. Such properties of the ^{3}H-labeled steroids may influence their biochemical behavior. The separation of tritium-labeled from nonlabeled or ^{14}C-labeled steroids on paper partition chromatograms was described and its implications discussed. In addition, cortisol-1,2-^{3}H and cortisol-4-^{14}C were administered simultaneously to a normal man, and labeled steroids from urine and plasma, collected at intervals during the first 24 hr, were isolated by paper chromatographic procedures. All metabolites exhibited chromatographic separation of the ^{3}H-containing moiety from the nonlabeled or ^{14}C-labeled compounds. However, no isotope effect was discernible for the in vivo metabolism of cortisol-1,2-^{3}H. When care was taken to analyze the total chromatographic peak areas, the proportions of ^{3}H : ^{14}C in the isolated metabolites (cortisol, cortisone, 3α, 11β, 17,21-tetrahydroxy-5β-pregnan-20-one, 3α,17,21-trihydroxy-5β-pregnane-11,20-dione), and a mixture of the cortolones were identical with that in the administered steroids. (BBB)

24314 CHANGES IN MACROMOLECULES PRODUCED BY IONIZING RADIATIONS. Alexander, P. (Royal Cancer Hospital, London). pp 183-213 of Handbuch der Medizinischen Radiologie. Vol. 2. Part 1. Diethelm, L.; (and others); (eds.). Berlin, Springer-Verlag, 1966.

This review (with 66 references) considers the following topics: macromolecules as the initial site of radioinduced biochemical lesions; different types of effects induced in macromolecules; radioinduced cross-linking and degradation of synthetic polymers; structural modification of proteins, nucleoproteins, nucleic acids, and polysaccharides; and the biological implications of radioinduced effects in macromolecules. Differential effects of various types of ionizing radiations are also considered. It was concluded that it is not possible to relate damage at the chemical level with damage to critical macromolecules. (BBB)

24315 STUDIES ON THE METABOLISM OF THE NUCLIDES OF Ca AND Sr IN MAMMALS. NOTE I. RETENTION OF ^{85}Sr IN THE RAT. Fasella, P.; Giacomelli, G.; Rimondi, O. (Univ., Rome). Ital. J. Biochem., 15: 50-9(Jan.-Feb. 1966).

Young and old Wistar rats were given an intramuscular injection of ^{85}Sr, and the retention and elimination of radioactivity were followed. Direct measurements of the whole-body radioactivity of the animal in vivo were carried out, and the radioactivity of the excreta was also estimated. The results of the 2 methods of assessment of Sr retention were analyzed and compared. The method based on direct measurement of whole-body radioactivity was found to be more practical and accurate, especially for long-term experiments. The errors of measurements were between ±1% and ±3% depending upon the amount of ^{85}Sr present in the animal. The experiments were continued for about a year from the time of ^{85}Sr

injection. The results were used to construct both individual and group ^{85}Sr retention curves and were markedly consistent for each group of animals. Animals contaminated when young were found to retain a much higher percentage of radioactivity than animals contaminated when older. This difference could still be observed long after ^{85}Sr administration. The results are discussed in relation to bone physiology with particular reference to the biological damage which may result from the deposition of the radionuclide in bone. (BBB)

24316 IN VIVO UPTAKE OF RADIOIODIDE BY RAINBOW TROUT. Hunn, J. B. (Fish and Wildlife Service, La Crosse, Wis.); Fromm, P. O. J. Water Pollut. Contr. Federation, 28: 1981-5(Dec. 1966).

Rainbow trout (Salmo gairdneri) weighing from 31 to 203 g were exposed to carrier-free $Na^{131}I$ (0.2 to 5.5 μCi/l) in 2 l of solution in covered plastic containers, with constant aeration and illumination. Results showed that radioiodide is taken up by trout via the gills, a process not affected per se by the osmotic gradient between the fish and the medium. Uptake was found to be inversely related to the Ca concentration of the medium. Thiocyanate competitively inhibited ^{131}I uptake by the gill but thiouracil given intraperitoneally was without effect during the 24-hr experimental period. The relative distribution of ^{131}I indicated that the lower jaw (thyroid) was the only tissue studied in which radioiodide attained a concentration above that of the blood. Thyroidal ^{131}I uptake was inhibited by NaSCN but thiouracil had no effect on uptake for at least 24 hr after injection. The ability of fish to take up radioiodide directly from the environment as well as by feeding indicates that they would be useful as indicators of environmental ^{131}I contamination. It is also suggested that fish should be included in surveys of aquatic biota around atomic power reactor installations since contamination of the fish population with ^{131}I could lead to contamination of human being via consumption of sport or commercial fish from these areas. High levels of ^{131}I contamination also might damage fish populations through genetic damage in the ova or by radiation injury to the developing thyroidal tissue. (BBB)

24317 UPTAKE AND RELEASE OF ^{18}F BY HUMAN INTACT SURFACE ENAMEL IN VITRO. Dickworth, R.; Braden, M. (London Hospital Medical Coll. Dental School). Arch. Oral Biol., 12: 217-30(Feb. 1967).

The exchange of ^{18}F by extracted human teeth was studied in both aqueous solutions and dentifrices. Analysis of the kinetics of uptake from aqueous solutions showed the uptake to be a process of diffusion with simultaneous chemical reaction; furthermore, the mathematical theory developed proved to be consistent with the observed experimental behavior. The preponderance of isoionic exchange in the uptake process demonstrated earlier was confirmed. Uptake from dentifrices also proved to be diffusion controlled; diffusion of ions through the dentifrice appeared to be the rate-controlling process. (BBB)

24318 EXCHANGE OF RADIOACTIVE CATIONS BY SOMATIC AND CARDIAC MUSCLES OF THE CRAYFISH. van der Kloot, William G. (New York Univ. School of Medicine, N. Y.). Comp. Biochem. Physiol., 17: 1019-43(Mar. 1966).

Intracellular concentrations of Na^+, K^+, Ca^{2+}, and Mg^{2+} were measured in a somatic muscle and in the heart of the crayfish. The uptake and the efflux of ^{24}Na, ^{42}K, ^{45}Ca, and ^{89}Sr were also measured. The initial influx rates of the ions from van Harreveld's solution into resting somatic muscle (in μEq/g cell water/hr) are: $K^+ = 25$; $Na^+ = 56$; $Ca^{2+} = 38$. Similar figures were obtained for the heart muscle. The calculated permeability constants (X 10^8 cm/sec) are: $P_K = 64$; $P_{Na} = 30$; $P_{Ca} = 10$; $P_{Sr} = 1.5$. The stimulation of the muscle fiber leads to an additional Ca^{2+} influx of about 2.8 pEq/cm^2 fiber surface. The additional Ca^{2+} uptake is sufficient to account for the change in potential on the membrane. When muscles were immersed in Sr^{2+} solutions, no additional ^{89}Sr uptake was found with stimulation. However, there is a high resting ^{89}Sr uptake and the muscle in Sr^{2+} has a long refractory period, so a reasonable increase in ^{89}Sr uptake would not be detectable. The results are discussed in relation to the divalent cation mechanism for generating action potentials and to the part played by Ca^{2+} in triggering muscle contraction. (BBB)

24319 RADIATION EFFECTS OF BIOLOGICAL MOLECULES. IV. MAGNETIC RESONANCE STUDY. Matsuura, Tomio; Koizumi, Yoshiharu (Tokyo Univ.). Proc. Fac. Eng. Tokai Univ., 1965: No. 2, 47-61(May 1966). (In Japanese).

The NMR spectra of D_2O solutions of D-ribose and nucleosides, which are irradiated by uv or ^{60}Co γ, are reported. By irradiation, newly produced signals of above materials are determined by comparison of signals from bases and D-ribose, and G values are obtained. (auth)

24320 PHOTOREACTIVATION OF THE ULTRAVIOLET-DAMAGED STREPTOMYCIN RESISTANCE MARKER IN DNA OF STREPTOCOCCI AND PNEUMOCOCCI. Pakula, R.; Hulanicka, E.; Walczak, W. (State Inst. of Hygiene, Warsaw). pp 313-14 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.

Problems encountered in demonstrating the photoreactivation of uv-irradiated streptococcal and pneumococcal DNA using Escherichia coli extracts are reported. Extracts of E. coli prepared by grinding bacteria with sand until over 90% of cells had been disrupted, designated No. I extract, gave a photoreactivation effect of 15 to 55% in uv-irradiated DNA of Hemophilus influenzae. However, all these extracts were not active in photoreactivation of streptococcal and pneumococcal DNA, and exerted a strong inhibiting effect on transformation of the cocci. This inhibition was found to be due mainly to the abundant amounts of E. coli DNA present in the extracts. This DNA competed for competent cells with transforming DNA of streptococci and pneumococci but not of H. influenzae. Various attempts to remove the inhibitory DNA from the extracts without destroying the factor necessary for photoreactivation were unsuccessful. The method of preparing the E. coli extracts was changed so that bacteria were grown for only 8 to 12 hr, ground to destroy 30 to 40% of cells, and extracted with distilled water or phosphate buffer. This type of extract, designated No. 2, was less inhibitory in transformation of pneumococci but did not differ significantly in this respect with respect to transformation of streptococci. With these extracts a slight but distinct photoreactivation effect could be produced. No explanation was found for the fact that both kinds of extract, No. 1 and No. 2, a are active in photoreactivation of uv-irradiated DNA of H. influenzae but only the latter in photoreactivation of coccal DNA's. (BBB)

24321 ULTRAVIOLET EFFECTS AND PHOTOREACTIVATION IN ISOLATED CELL FRACTIONS. Fisher, W. D.; Cline, G. B. (State Univ. of New York, Syracuse). pp 308-10 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.

Experiments were designed to test whether any mechanism similar to that described for the photoreactivation (PR) of the transforming activity of DNA could be demonstrated for the repair of uv-inactivated enzymes, and whether isolated cell particulates could be photoreactivated. DNA polymerase and the isolated nucleus were studied because the nucleus and DNA are probable sites of uv damage in the cell. The uv inactivation curves for the incorporation of 1-^{14}C-alanine and ^3H-thymidine by thymus nuclei and of ^3H-thymidine by soluble DNA polymerase showed that inactivation is exponential, provided sufficiently thin samples are used. The nucleus showed a similar sensitivity to uv for both amino acid and thymidine incorporation. The nucleus is 70 times as sensitive to uv as the polymerase. Typical values for incorporation by unirradiated samples were: 300 cpm/mg protein for ^{14}C by the nucleus, 5×10^3 cpm/mg DNA for ^3H by the nucleus, and 4×10^5 cpm/mg DNA for ^3H by the polymerase. Incorporation was nearly proportional to enzyme or nuclear concentration and to incubation time. The soluble DNA polymerase system did not photoreactivate under the conditions of the experiments (up to 10^6 erg/mm^2 after uv inactivation). Alanine incorporation by uv-irradiated nucleu was increased about 30% by exposure to photoreactivating light. Addition of 1 mg of DNA primer to nuclei increased alanine incorporation by 30 to 40% in unirradiated and uv-inactivated nuclei. The results suggest that damage to the enzyme is probably not a factor in uv inhibition of DNA synthesis in vivo. This follows from the very large exposures required to affect incorporation in the soluble system. The nucleus, by contrast, is quite sensitive. The block in synthesis must, therefore, be at a different level than the polymerizing enzyme. (BBB)

24322 PHOTOENZYMATIC REPAIR OF ULTRAVIOLET DAMAGE IN DNA. Rupert, C. S.; Herriott, R. M. (Johns Hopkins Univ., Baltimore). pp 311-12 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.

Ultraviolet-damaged bacterial transforming DNA can be photoreactivated in vitro by enzyme systems obtained from photoreactivable cells, indicating that photoreactivation of cells involves repair of uv damage to cellular DNA. Two components, one dialyzable and heat stable that was used up in the reaction and one nondialyzable and heat labile which was not consumed, were implicated in repair in the Escherichia coli system. No stoichiometric relation was found between the amount of this supposed dialyzable component and the amount of DNA repaired, although preparations lose activity upon dialysis and recover upon adding back concentrated dialysate. In yeast, an enzyme in the dark forms a stable complex with uv-irradiated DNA, and this sediments in an ultracentrifugal field at the high rate characteristic of DNA rather than the slower rate characteristic of the free enzyme. The complex dissociates in the light to generate a repaired DNA structure and free enzyme. This photoenzyme system

resembles the retinene-opsin-rhodopsin system of vertebrate rod vision, although the two systems are chemically different. The same formal pattern may hold for the primary events underlying other photobiological processes. The presence of photoreactivable damage in uv-irradiated nontransforming DNA may be detected by its competitive inhibition of transforming DNA repair. This inhibitory power is eliminated by allowing the enzyme to act on the irradiated competing DNA first. By these criteria, photoreactivable damage develops in all kinds of mammalian, bacterial, and viral DNA tested, including single-stranded DNA. It also develops in heat-, acid-, and alkali-denatured DNA, and once present, survives in DNA treated at 100° for 40 min or at pH 2.5 or 12.5 overnight at room temperature. It does not develop when irradiation of denatured DNA occurs at a pH below 3.0 to 3.5, the region in which purine and pyrimidine amino groups become protonated. No competitive inhibition was found with irradiated RNA. (BBB)

24323 PHOTOREACTIVATION AND REVERSIBLE PHOTOLYSIS OF NUCLEIC ACIDS. Shugar, D. (Inst. of Biochemistry and Biophysics, Warsaw). pp 315-19 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.

Evidence relating to the concept that photoreactivation (PR) is due to a reversal of uv damage to essential nucleic acid molecules is reviewed. The available evidence indicates that PR operates predominantly via reversal of uv damage rather than by the initiation of alternative metabolic pathways. Physico-chemical reversal of the effects of uv on natural and model polynucleotide chains can be obtained to the extent of 50% or more of the damage inflicted, or about that prevailing for biological PR. Reversible photolysis of pyrimidine residues in nucleic acids consequently provides a reasonable experimental analog for biological PR. The principal criticism which may be leveled at this model is that reversibility has hitherto been obtained mainly by heating at neutral pH, i.e., it is thermal reversibility (TR) and not PR. Agents other than visible light may be used to reverse the effects of uv on biological systems and, of all these, the one that most closely resembles PR is TR. Each of these may therefore be considered as a different source of energy for effecting the reverse reaction. The processes occurring in an irradiated nucleic acid chain and subsequent PC are visualized as follows. In both single and twin-stranded chains in those regions which contain tracts of pyrimidines, a fraction of the latter undergoes a reaction which is nonreversible by acid or heat and is due to cross-linking of the 5,6 double bonds of adjacent pairs of pyrimidines. Most of them as well as many of those distributed randomly in the chain become hydrated at the 5,6 double bond. In a single-stranded chain the secondary structure may be slightly modified as a result of H bond breakage to an affected base. In a twin-stranded chain some of the interchain H bonds would also be ruptured. The net result is a localized modification of base sequences accompanied by a slight loss in secondary structure for a single-stranded chain and in secondary structure and interchain bonding for a twin strand. The PR enzyme system may act on irradiated DNA by removing a water molecule from the 5,6 bond of pyrimidine residues. (BBB)

24324 BIOLOGICAL ACTIONS OF DIMETHYL SULFOXIDE. Leake, Chauncey D. (ed.). Ann. N. Y. Acad. Sci., 141: 1-671 (Mar. 15, 1967).

Separate abstracts were prepared on three papers. Numerous reports are included that discuss the basic pharmacology, biochemistry, metabolic effects, metabolism, mode of action, and results of clinical experiments, and the usefulness of DMSO in veterinary medicine. (B.H.S.)

For abstracts of individual papers see: 24477, 24478, and 24480.

24325 THYROID UPTAKE OF ^{99m}Tc PERTECHNETATE. Kuba, J.; Wiedermann, M.; Komenda, S. (Palacky Univ., Olomouc, Czechoslovakia). Nucl.-Med., 6: 53-64(1967). (In German).

The uptake of ^{99m}Tc-pertechnetate by the thyroid gland was studied in 159 patients 30 min following intravenous administration of the isotope. In normal patients the average 30-min uptake was found to be 2.47 ± 1.09% and in hyperthyroid patients 18.2 ± 8%. In hypothyroid patients and in subjects with partial or full blockage of the thyroid due to various iodine preparations, the uptake of ^{99m}Tc-pertechnetate ranged from 0 to 1% of the administered dose. Triiodothyronine administration reduces ^{99m}Tc uptake by the normal thyroid gland. As with radioiodine uptake, this suppression test was negative in hyperthyroid patients. Dependence of ^{99m}Tc-pertechnetate uptake on TSH-stimulation in euthyroid patients was confirmed. In 149 subjects, the thyroid uptake of ^{131}I and of ^{99m}Tc-pertechnetate was determined and a positive correlation was found between the results of the two methods. In view of the possibility of using ^{99m}Tc-pertechnetate for the diagnosis of hyperthyroidism, the total fraction of wrong diagnoses was determined at the empirically assessed optimal limit between thyroid hyperfunction and eufunction. Assuming an upper limit of 4.5% for the uptake of ^{99m}Tc in euthyroid subjects, a minimal total error of 7% was found. (tr-auth)

24326 SODIUM ABSORPTION BY BARLEY ROOTS: ROLE OF THE DUAL MECHANISMS OF ALKALI CATION TRANSPORT. Rains, D. W.; Epstein, Emanuel (Univ. of California, Davis). Plant Physiol., 42: 314-18(Mar. 1967).

Radioactively labeled Na^+ absorbed by barley roots was sequestered in an intracellular compartment or compartments in which it was only very slowly exchangeable with exogenous Na^+. Absorption of this fraction proceeded at a constant rate for at least 1 hour. When the rate of Na^+ absorption was examined over the range of concentrations, 0.005 to 50 mm, the isotherm depicting the relation showed dual kinetics as follows. Over the range, 0.005 to 0.2 mm, a single Michaelis-Menten term describes the relation between the concentration of Na^+ and the rate of its absorption. The mechanism of Na^+ absorption operating over this range of concentrations, mechanism 1 of alkali cation transport, is severely inhibited in the presence of Ca^{2+} and virtually rendered inoperative for Na^+ transport by the combined presence of Ca^{2+} and K^+. The mechanism is equally effective in Na^+ transport whether Cl or F^+ is the anion, but is somewhat inhibited when the anion is SO_4^{2-}. Over the high range of concentrations, 0.5 to 50 mm Na^+, a second, low-affinity mechanism of Na^+ absorption comes into play. In the presence of Ca^{2+} and K^+, this mechanism 2 is the only one to transport Na^+ effectively, since Na^+ absorption via mechanism 1 is virtually abolished under these conditions. Anaerobic conditions, low temperature, and the uncoupler, 2,4-dinitrophenol, inhibit Na^+ absorption both at low and high Na^+ concentrations. (auth)

24327 MAMMALIAN LIPOIC ACID ACTIVATING ENZYME. Tsunoda, Joyce N.; Yasunobu, Kerry T. (Univ. of Hawaii, Honolulu). Arch. Biochem. Biophys., 118: 395-401(Feb. 1967).

The presence of a lipoic acid activating enzyme has been demonstrated in animal liver and a 50-fold increase in the specific activity of the enzyme was achieved. Some of the general properties of the labile enzyme were determined on the partially purified preparations. The substrate specificity of the enzyme is rather broad and a number of lipoic acid analogues can be converted to the hydroxamate derivative. The enzyme catalyzes a ^{32}PP–ATP exchange reaction and the cofactor requirements are the same for both the forward and exchange reactions confirming the occurrence of the enzyme in animal liver. (auth)

24328 RENAL STORAGE AND EXCRETION OF ^{203}Hg–MERCURIC CHLORIDE BY THE RAT. Dreisbach, R. H.; Taugner, R. (Univ., Heidelberg). Nucl.-Med., 5: 421-35 (1966). (In German).

The urinary excretion, filtration, renal flow and renal storage of mercuric chloride were studied in rats using ^{203}Hg-mercuric chloride. Constriction of the aorta and ligation of the ureters served to vary renal blood flow and volume of filtrate. Results obtained with functional methods were related to the various segments of the tubules as demonstrated by autoradiography of frozen sections of various regions of the kidney. The findings suggest that the initial Hg-uptake by the convoluted tubule of the renal cortex takes place not only via the basal membrane but also through filtration-reabsorption. The subsequent Hg-storage in the terminal tubule appears to be brought about by reabsorption of filtrated or further proximally secreted mercuric chloride. These new view points can be used to re-interpret renal distribution patterns previously described. (auth)

24329 CERTAIN DATA FOR DETERMINING THE BIOLOGICAL CONSTANTS OF URANIUM SOLUBLE COMPOUNDS IN A TEST ON ALBINO RATS. Guskova, V. N.; Zasedatelev, A. A.; Kupriyanova, V. M.; Shamov, V. P. (Leningrad Scientific-Research Inst. for Radiation Protection). Gig. Sanit., No. 11, 39-42(Nov. 1966). (In Russian).

Sorption, distribution, and excretion of soluble salts of uranium were studied in rats administered a single dose of uranyl nitrate (0.7 mg/kg) or daily doses per os for 12 months (to a total dose of 16 mg/kg). Urinary excretion of uranium was 43% at 1.8 days and 57% at 15.5 days; bone retention values were 76% at 24 days and 24% at 400 days; and whole-body retention was 85% at 20 days and 15% at 400 days. (H.G.D.)

24330 STEREOSPECIFICITY OF THE ALLOSTERIC NADH DEHYDROGENASE FROM MYCOBACTERIUM TUBERCULOSIS. Worcel, A.; Goldman, Dexter S. (Veterans Administration Hospital, Madison, Wis. Univ. of Wisconsin, Madison). Arch. Biochem. Biophys., 118: 420-3(Feb. 1967).

The electron chain-linked, allosteric NADH dehydrogenase from Mycobacterium tuberculosis is a 4-B NADH specific enzyme, and does not catalyze NADH-H_2O H-exchange. AMP activation of this dehydrogenase does not affect the stereospecificity of the H removal from NADH and has no effect on the lack of NADH–H_2O H-

exchange. A soluble, AMP sensitive NADH-menadione oxidoreductase can be extracted from the particulate NADH oxidase complex. This soluble diaphorase, as well as the soluble NADH nitro-blue tetrazolium oxidoreductase present in cell-free extracts of this microorganism are also 4-B NADH specific enzymes and do not catalyze the NADH–H_2O H-exchange reaction; this is taken as further proof that the soluble diaphorases from M. tuberculosis are derived from the membrane-bound NADH oxidase complex. (auth)

24331 INCORPORATION OF LABELED AMINO ACIDS INTO SERUM AND TISSUE PROTEINS FROM NORMAL AND X-IRRADIATED MICE. Reuther, A. M.; Sassen, A.; Kennes, F. (Centre d'Etude l'Energie Nucleaire, Mol, Belg.). Radiat. Res., 30: 445-54(Mar. 1967).

Incorporation of ^{3}H-L-phenylalanine and ^{3}H-L-tryptophan into serum and tissue proteins has been studied in normal and x-irradiated mice. After doses of 700 R and 1000 R, incorporation was increased rather than decreased. A higher specific activity was found in the fractions that decrease in concentration after irradiation. A decrease in the pool size and specific activity of free amino acids in the liver or spleen cannot be responsible for this effect. Thus, the high specific activity of fractions such as γ-globulins, which are decreased in concentration after irradiation, would indicate an increased synthesis. (auth)

24332 THE RADIOSENSITIVITY OF BACTERIOPHAGE DNA IN AQUEOUS SOLUTION. Blok, Joh.; Luthjens, L. H.; Roos, A. L. M. (National Defense Research Organization TNO, Rijswijk, Netherlands). Radiat. Res., 30: 468-82(Mar. 1967).

The effect of soft x rays on the biological activity of air-saturated aqueous solutions of single-stranded DNA of the bacteriophage φX174 was studied. The inactivation is due to OH radicals, as follows from the large increase of the 37% survival dose if these radicals are scavenged by iodide ions. O_2^- radicals, produced by the reaction of hydrated electrons with oxygen, do not inactivate DNA. In dilute solutions of DNA the inactivation rate at low dose was much smaller than expected from the rate of base destruction as determined from the decrease of optical density at higher dose. This could be explained from the nonuniform nucleotide concentration in such solutions, which enhances the scavenging efficiency of impurities. At DNA concentrations above 1 mg/ml this effect disappears gradually. The protection afforded by various concentrations of a mixture of free nucleotides in a molar ratio corresponding to the base composition of DNA indicates that free nucleotides react faster with free radicals than do nucleotides in DNA. (auth)

24333 FREE AMINO ACIDS IN GAMMA-IRRADIATED CARROTS. Bourke, J. B.; Stillings, B. R.; Massey, L. M. Jr. (Cornell Univ., Geneva, N. Y.). Radiat. Res., 30: 569-75 (Mar. 1967).

Studies were conducted to determine the effect of ^{60}Co γ radiation on the radiosensitivity of free amino acids in metabolizing carrot tissue and on the synthesis of free amino acids from ^{14}C specifically labeled acetate. At 100-krad doses, the concentration of some amino acids decreased; at 500 krads, all were depressed; and at 1000 krads, the concentration of all amino acids was severely reduced. With the exception of isoleucine, glycine, valine, and phenylalanine, synthesis from labeled acetate of all amino acids occurred, with glutamate, serine, and aspartate being synthesized in the greatest amounts. In general γ radiation reduced synthesis from labeled acetate at all doses above 100 krads and severely inhibited synthesis at 1000 krads. Incorporation of the carboxyl carbon of acetate was generally less extensive and more radiation-reduced than that of the methyl carbon. (auth)

24334 LASER EFFECT ON DENTAL HARD TISSUES: A PRELIMINARY REPORT. Stern, Ralph H.; Sognnaes, Reider F. (Univ. of California, Los Angeles). J. S. Calif. Dent. Ass., 33: 17-19(Jan. 1965).

An investigation of the effects of radiation laser on enamel, dentin, and certain restorative materials was carried out on extracted human teeth. The 2 types of laser beams used differed in that one had a higher (5-20 J) energy output with a (10-30 milliradians) wide laser beam and the other had a low (2-5 J) energy output but with a narrower, more finely focused beam. Intensive laser beam exposure focused on a small area affected enamel by causing the formation of a crater. This crater had a pointed floor and a rounded lip. The enamel on the lip of the crater had a glass-like fused appearance. Evidently, the structure does not become entirely amorphous since laser exposed enamel retained some of its crystallographic properties. When intact dentin was exposed to a laser beam, comparable energies burned a more definite crater which, due to its higher organic content, showed charring. The effect of laser on a dental restorative metal was examined by exposing a gold foil restoration to the beam. The metal absorbed much more energy than the enamel, resulting in considerably greater destruction of the metal. Efforts to fuse powdered substances with the enamel were unsuccessful. (BBB)

24335 MICROSURGICAL APPLICATION OF A PULSED RUBY LASER IN EXPERIMENTAL CELL BIOLOGY. Leppard, Gary G. (Yale Univ., New Haven); Wacker, Gerhart. Photochem. Photobiol., 5: 631-43(Aug. 1966).

Effects of laser radiation produced on biological material as a function of the instrumentation variables used to control the incident radiation are discussed, and microsurgical applications of a pulsed ruby laser used in conjunction with a multi-objective microscope are considered. Some design criteria and various technical and practical problems relating to such use of a laser-microscope complex are outlined. Control of the volumetric energy density at the specimen by instrumentation variables was established on the basis of systematic studies conducted on a stained protein model tissue. The instrumentation variables offering the greatest degree of control were the beam energy, the objective focal length, and the degree of defocusing of the laser beam. Results of the model tissue study enabled prediction in advance of the size and severity of destructive effect that would be produced in thin layers of green plant tissue using a particular combination of variables. Extension of these results enabled single cell and intracellular microsurgery to be performed with precision. In addition, various biological tests and experiments were conducted in order to determine the applicability of a laser-microscope system to biological research and to delineate its limitations. (BBB)

24336 THYMINE DIMERIZATION IN L-STRAIN MAMMALIAN CELLS AFTER IRRADIATION WITH ULTRAVIOLET LIGHT AND THE SEARCH FOR REPAIR MECHANISMS. Klimek, Miros (Inst. of Biophysics, Brno). Photochem. Photobiol., 5: 603-7 (Aug. 1966).

These studies were designed to determine: whether dimers of thymine arise in mammalian cells in vitro, and if so, whether the amount of dimer formed is proportional to the dose of uv radiation, and whether any dimer is eliminated from the DNA of irradiated cells in the course of postirradiative incubation. The results demonstrated that thymine dimers did form in the DNA of L-strain mammalian cells after irradiation with uv light and that the amount of dimer formed increased with the dose of uv light. In the course of postirradiation incubation the thymine dimers and other thymidine-^{3}H derivatives remained in the trichloroacetic acid-insoluble fraction and diminished as incubation time increased. The dimer was not found in the soluble fraction. Thus, dimer excision (that is, its liberation into the soluble fraction) as an expression of repair of radiation damage that is analogous to dark repair in Escherichia coli was not found in these experiments. (BBB)

24337 MATHEMATICAL AND PHYSIOLOGICAL MODEL FOR EARLY DISTRIBUTION OF RADIOIODIDE IN MAN. Hays, Marguerite T.; Wegner, Louis H. (Univ. of California, Los Angeles). J. Appl. Physiol., 20: 1319-28(Nov. 1965).

The model described for the early distribution of radioiodide in man is formalized as a set of 8 simultaneous differential equations, each predicting the rate of change of radioiodide in a compartment. These equations were fitted by numerical integration on a digital computer to plasma curves from sessions with and without aspiration of gastric contents, curves of the aspirated radioiodide, and thyroidal and renal plasma clearance rates. In this model, plasma radioiodide is distributed reversibly to the erythrocytes, interstitial fluid (space E) and a slowly diffusible space (space C). Distribution to the thyroid and kidney is irreversible. Radioiodide distributed to the salivary glands and gastric mucosa must pass through a gastrointestinal cycle before eventual reabsorption from the intestine. Successive compartments of this cycle are the inaccessible gastric space (space M), free gastric juice (space S), and the intestine (space D). All of the modes of distribution mentioned are governed by rate constants except for transfer from space S to space D, which occurs as a complete transfer at a fixed interval τ. (BBB)

24338 EFFECT OF X-IRRADIATION ON PHOSPHATASE ACTIVITY IN THE INTESTINE OF THE GOLDFISH, CARASSIUS AURATUS, AT DIFFERENT TEMPERATURES. Hyodo, Yasuko (National Inst. of Radiological Sciences, Chiba, Japan). Annot. Zool. Jap., 39: 119-27(Sept. 1966).

The effects of temperature on the activity and localization of alkaline and acid phosphatases in intact and x-irradiated goldfish were studied histochemically. The intestine of non-irradiated control fish kept at 25°C exhibited a strongly positive reaction to both phasphatases. Although the distribution pattern in these fish between alkaline and acid phosphatases was slightly different, the two enzymes were largely distributed toward the luminal border of the epithelial cells. The enzyme distribution was ap-

proximately the same irrespective of water temperature (4°C and 25°C). However, the intestinal enzyme reaction was much stronger in fish kept at 25°C than in those placed at 4°C. Whole body irradiation with 8 kR of x rays at 25°C evoked between 6 and 24 hours after exposure an increase in activity of alkaline and acid phosphatases along the luminal part of the intestinal epithelium. However, on the 3rd or 4th day after irradiation the activity fell below the control level. On the 8-10th days, i.e., immediately before death of the fish, it was approximately the same as that in non-irradiated control fish. If irradiated fish were kept at 4°C before and after exposure, activity of the enzymes was not affected for a period as long as 100 days. No direct correlation was found between changes in phosphatase activity and "intestinal death" of irradiated fish. (NSA of Japan)

24339 EFFECTS OF CALCIUM SODIUM ETHYLENE-DIAMINETETRAACETATE ON THE KINETICS OF DISTRIBUTION AND EXCRETION OF LEAD IN THE RAT. Castellino, N.; Aloj, S. (Univ., Naples). Brit. J. Ind. Med., 22: 172-80(July 1965).

The effects of calcium sodium ethylenediaminetetraacetate ($CaNa_2EDTA$) on the kinetics of distribution and excretion of ^{210}Pb were studied in rats. When the chelant was given intravenously, at 50 mg/rat daily after a single intravenous injection of 100 μg lead/rat, it greatly increased urinary excretion of lead but reduced fecal excretion of lead. The greatest effects occurred in rats treated with chelant shortly after lead injection. When the chelant was given 7 or more days after an injection of ^{210}Pb, the increase in lead excretion was negligible. $CaNa_2EDTA$ mobilized lead from every tissue, but kinetic analysis of the disappearance of ^{210}Pb showed the presence of two elimination phases. Lead-210 ions weakly bound to cells were rapidly removed by EDTA; whereas, ^{210}Pb fixed to intracellular constituents was removed slowly. The chelant did not mobilize ^{210}Pb from bone. Probably $CaNa_2EDTA$ entered the extravascular space but not cells. Hence the effect was an acceleration of the passage of lead from cells since the concentration of lead outside cells was lowered. In addition, ^{210}Pb was given orally in doses of 500 μg lead/rat. About 18% of the dose was absorbed via the intestine and was distributed to all tissues. In rats treated orally with $CaNa_2EDTA$ an increase in urinary ^{210}Pb excretion and a reduction in amount of lead fixed in the body was observed. (BBB)

24340 STUDIES ON THE TRANSFORMATION OF WATER IN LEAVES WITH TRITIATED WATER. I. INTRODUCTION: BIBLIOGRAPHIC STUDY OF THE PROBLEMS POSED BY USE OF LABELED WATER IN PLANT PHYSIOLOGY. Costes, C.; Ferron, Francoise; Van Assche, J.; Deroche, Marie-Esther (Centre National de Recherches Agronomiques, Versailles, France). Ann. Physiol. Veg., 6: 303-15(1964). (In French).

The use of ^3H- and ^{18}O-labeled water for study of plant metabolism is reviewed. In addition to a survey of experimental results, techniques for counting tritium in biological systems are described, including use of gas counters and scintillation counters, characteristics of various scintillators, measurement procedures for ^3H, simultaneous counting of ^3H and ^{14}C, and the effect of extinction. The use of tritiated water in the study of transformations (photosynthesis and transpiration) of water in green leaves is examined. The main difficulties are in isotopic exchange and mass discrimination. Exchange of water molecules allows them to reach rapidly every enzymatic site where water is metabolized. Nevertheless, it is necessary to measure the rate of exchange of tritium between water and hydrogen from organic molecules. Tritium toxicity does not appear, for it is possible to use very low concentrations of ^3H_2O in physiological experiments. But mass discrimination decreases the reactions rate in which tritiated molecules are involved, so that mass discrimination is a hindrance in interpretation of experimental results. This difficulty disappears in comparative experiments between 2 species of plants. Liquid scintillation techniques which allow counts of radioactivity in various tritiated compounds are discussed. (BBB)

24341 EFFECT ON GASEOUS METABOLISM IN MICE FOLLOWING DIFFERENT TYPES OF RADIATION. Furukawa, Yoshinori; Matsuoka, Osamu (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 894-8(Oct. 1966). (In Japanese).

The effects of radiation on gaseous metabolism of mice was studied using sources such as x rays, ^{60}Co γ rays and internally administered ^{131}I and ^{90}Sr. Oxygen consumption and CO_2 production in irradiated mice were determined by Scholanders micro-gas analyzer. X-irradiation of 1,500 R gradually depressed the gaseous metabolism and resulted in the death of mice, 600 R brought about increased metabolism within 3 days after irradiation, which recovered to normal level by two weeks, and 300 R failed to show any detectable effect. By the ^{60}Co γ-irradiation of about 600 R, slightly increased metabolism was increased during the two weeks following ^{60}Co γ irradiation (600 R). The results of dose-rate studies showed that respiration was affected more by lower dose rates. Changes in gaseous metabolism induced by internal irradiation by ^{90}Sr or ^{131}I, injected intraperitoneally was not so evident as in the case of external irradiation. (auth)

24342 ACTIVITIES OF ACID PHOSPHATASE, PEROXIDASE, AND POLYPHENOLASE IN ETIOLATED SHOOTS FROM CONTROL AND IRRADIATED MAIZE SEEDS. Haskins, F. A.; Downs, S. C. (Univ. of Nebraska, Lincoln). Agron. J., 53: 90-3(1961).

Seeds of the single-cross maize hybrid, L289 × 1205, were given x-ray and thermal neutron treatments. Etiolated shoots from control and irradiated maize seeds were dissected into the 3 major portions, first internode, coleoptile, and unexpanded foliage leaves. Preparations of these 3 portions were assayed for activities of acid phosphatase, peroxidase, and polyphenolase. Specific activities of acid phosphatase and peroxidase in the leaf preparations increased significantly with dose of irradiation; otherwise, no significant irradiation-induced differences were observed. Consideration of the contributions of the 3 shoot portions toward total fresh weight and enzymatic activities indicated that activity distribution patterns of acid phosphatase and peroxidase were altered by the irradiation treatments. The contributions of each shoot portion toward the total activities of acid phosphatase, peroxidase, and polyphenolase were significantly correlated with respective fresh weight contributions of the portions. In the case of polyphenolase a negative correlation coefficient was obtained, while for the other 2 activities the correlation coefficients were positive. Comparison of results obtained with irradiated material and untreated material of various ages indicated that radiation-stunted shoots differed metabolically from shoots which were short by virtue of being young. (BBB)

24343 RADIATION CLEARANCE OF BONE: PRELIMINARY REPORT. Miki, I.; Ito, T. (Tokyo Univ.). Angeiologie (Paris), 16: 13-25(July-Aug. 1964).

The rate of clearance of locally injected radioiodine was studied in the tibia of dogs and rabbits. After drilling a hole in the bone, a needle was inserted and 0.5 to 3 μCi of ^{131}I was injected in saline. By use of a shielded detector counts were recorded directly from the bone to follow disappearance of ^{131}I from the site of injection. To establish the reproducibility in the measured values of this test, injections were repeated in the same site. Radioiodine diluted in 0.05 ml of saline solution was injected repeatedly, every 20 min, in the tibiofibula of a rabbit. The first, second, third, and fourth isotope clearance curves showed a similar triphasic pattern. The clearance of ^{131}I from the tibiofibular marrow of the rabbit or the dog was more rapid in comparison with that from other soft tissue. The half time for clearance of radioiodine from bone marrow was between 30 sec and 2 min under the described experimental conditions. The isotope clearance curve observed showed 3 phases by semilogarithmic analysis. The first phase is partially due to intravascular injection, as seen by injection of radioiodinated serum albumin (RISA) instead of $Na^{131}I$. RISA was not cleared after the first phase, which indicates that RISA removed by the lymph flow was minimal in the experimental conditions used. The reasons for the other two phases have not yet been determined. Some clinical studies using this method are also described. (BBB)

24344 THE MEASUREMENT OF ^{131}I UPTAKE OF THE RAT THYROID GLAND IN THE PRESENCE OF A SECOND EMITTER. Bergner, H. (Humboldt-Univ., Berlin). Arch. Tierernaehr., 15: 389-97(Dec. 1965). (In German).

The effect of simultaneous injections of ^{32}P on uptake of ^{131}I in the thyroid gland of rats fed high- and low-protein diets was studied. Evidence from preliminary experiments excluded the possibility that ^{32}P β radiation interfered with counting rates from ^{131}I in the thyroid gland. Impulse rates of ^{131}I and ^{32}P solutions obtained with a scintillation counter (Universal VA-S-961) demonstrated that only ^{131}I radiation from an ^{131}I–^{32}P solution was recorded by the scintillation counter. The course of ^{131}I uptake in rat thyroid glands, following an injection of ^{131}I, was measured on isolated intact thyroid glands and on incinerated thyroid glands by use of a scintillation counter and a liquid counter, respectively. Measurements yielded parallel results. Following simultaneous injections of ^{32}P and ^{131}I in rats fed different diets, the uptake of ^{131}I by the thyroid gland was measured with a scintillation counter. A low-protein diet increased ^{131}I activity of the thyroid. It was proposed that metabolic data on incorporation of ^{32}P in proteins and nucleic acids could be acquired simultaneously with ^{131}I thyroid metabolism data. (BBB)

24345 A NEW ^{32}P-LABELED RADIOCOLLOID: MECHANISM OF FORMATION AND BIOLOGICAL BEHAVIOR. Bellion, B.; Buechi, G.; Chiarle, S.; Orsello, S.; Rosa, U.; Sosi, S. (Univ., Turin). Panminerva Med., 7: 232-7(June 1965).

A study of the formation of colloidal complexes of trivalent chromium in alkaline solution in the presence of a protective colloid

revealed a general method for preparing different ^{32}P-labeled radiocolloid. The colloid obtained by this method was not chromic phosphate but chromic hydroxide complexed with potassium phosphate and gelatin. It was prepared in two phases: preformation of the colloidal base and then labeling of the high sp act. base with ^{32}P. A method was developed for preparing two colloidal bases which differed in micelle dimensions, 200-600 Å in one case and 1000-10,000 Å in the other. Both bases were labeled with ^{32}P and the biological behavior of the radiocolloids thus obtained was studied by means of interstitial injections in rabbits. The radiocolloid with micelles between 1000 and 10,000 Å in size was arrested to the extent of 95% at the injection site. The remaining 5% partially migrated into lymphatic pathways; it did not accumulate in the liver or in the hematopoietic organs. Distribution remained almost constant in time. The radiocolloid of smaller dimensions, while exhibiting an equal degree of stability, had a greater tendency to move away from the site of injection. Accumulations in the regional lymph node and liver were noted. (BBB)

24346 RIBONUCLEASE A AFTER UV IRRADIATION (λ = 254 nm): SPECTRAL PROPERTIES. Mueller, H. G. (Institut fuer Biophysik, Berlin). Acta Biol. Med. Ger., 16: 465-73(1966). (In German).

Monochromatic uv light with a wavelength of 254 nm decreased the enzymatic activity of ribonuclease, and uv absorption between 240 and 400 nm was increased. Protein absorption in this range is almost exclusively caused by tyrosine and tryptophan. Since the ribonuclease molecule lacks tryptophan, tyrosine was most likely responsible for this absorption. An oxidation product, such as 3-(3,4-dihydroxyphenyl)alanine may have been responsible for the spectral changes observed. Modified spectra observed that were similar to that of tyrosine suggested that this type of modification took place after uv-irradiation. The modification of individual amino acid residues causes complete loss of the natural structure. The decrease in extinction observed at 287 nm after heating of native ribonuclease is evidence of destruction of the protein molecule, when the non-covalent chromophore groups within the molecule are shifted outward. This phenomenon cannot be the case in uv-inactivated ribonuclease; therefore, it was concluded that the chromophores produced by photolysis were not located internally within the protein molecule like all of the unaltered remaining tyrosine residues. Thermostability of the ribonuclease also decreased after uv light inactivation, but the reason for this was not given. (BBB)

24347 DEUTERIUM OXIDE EXCHANGE IN ISOLATED GUINEA PIG TAENIA COLI. Elford, B. C. (National Inst. for Medical Research, London). J. Physiol. (London), 188: 29P-30P(1967).

The exchange of D_2O in isolated guinea pig Taenia coli was monitored continuously using an electronic microbalance to record the apparent wt of the tissue immersed in Krebs's solution with or without D_2O 20% (v/v). The difference between the densities of the bathing solutions with and without D_2O was measured accurately and was of the order of 0.02 g/ml. Equilibration of D_2O 20% (v/v) throughout a Taenia weighing 30 mg changed the apparent weight by about 500 μg and this was measured to an accuracy of $\pm$0.5 μg. Heavy water exchanged completely with water in the muscle in 2 distinct exponential phases. The ratio of the time constants for the 2 phases was about 3.5/1. Influx curves recorded by the microbalance were mirror images of the efflux curves for the same muscle providing that there was no change in the volume of the muscle during an experiment. The activation energies for the 2 component processes, determined by following the exchange in the temperature range 0°C to 25°C, were of the order of 4.5 Kcal/mole and the Q_{10} values were between 1.3 and 1.4. These parameters were not significantly different from those for the self-diffusion coefficients of water measured by means of tritiated, deuterated, and ^{18}O water, indicating that both phases of the exchange take place by the process of diffusion. The sizes of the 2 compartments in which D_2O is exchanged were determined using, as a model, a system consisting of 3 compartments in series. Analysis of the influx and efflux curves according to this model showed that the fast component represented exchange with 80 to 90% of the total water content of the taenia. Thus the fast and slow phases do not correspond with the exchange of extracellular and intracellular water respectively. The slow phase may represent exchange with water in the nuclei and the fast component exchange with the remaining water in the tissue. (BBB)

24348 ATHEROSCLEROSIS AND RADIOACTIVITY. Elkeles, Arthur (Princes of Wales' General Hospital, London). J. Amer. Geriat. Soc., 14: 895-901(Sept. 1966).

Since some radionuclides are preferentially deposited in bone, evidence was sought for their presence in calcifying arteries. Ash percentages and α activities were measured in abdominal aortas, in coronary and pulmonary arteries, and in costal cartilages from 107 consecutive coroner's necropsies on subjects aged 20 to 80 yr. Percentage of ash and the α activity rose only in the abdominal aortas and coronary arteries with age. In the pulmonary arteries, which are rarely affected by atherosclerosis, the ash percentage did not increase with age, and the α activity declined. Sex differences were found in ash concentrations and α activity in abdominal aortas and, in particular, coronary arteries. Both ash percentage and the wet-tissue radioactivity were higher in the abdominal aortas of females than males in the 70 to 80 age group. Women generally have a higher incidence of severe atherosclerosis of the abdominal aorta than men in this age group. An outstanding feature was the consistent rise of ash percentage and α activity in male coronary arteries with age. In contrast, α activity remained low in the coronary arteries of females up to the age of 70. It is proposed that a progressive deposition of Ca together with small but increasing amounts of α-emitting radionuclides lead to subtle injuries and to reactive changes in the connective tissues of the arterial wall, thus promoting development of atherosclerosis. (BBB)

24349 CIGARETTES, CANCER AND ^{210}Po. Med. J. Aust., 1: 548-9(Mar. 26, 1966).

Evidence is reviewed for the causation of lung cancer by ^{210}Po in cigarette smoke. It is found on the exposed foliage of plants, especially grass, in amounts varying in proportion to the local rainfall. Polonium-210 is completely volatile above 500°C, which is well below the temperature of a burning cigarette. It binds rapidly and firmly to surfaces, thus becoming attached to smoke particles. Its concentration in tobacco leaf from widely different areas, such as the United States, Rhodesia, Australia and India, is not very different, as might be expected from the similarity of the climatic conditions necessary for the growth of the leaf. Measurements of the concentrations of ^{210}Po in normal human tissues showed that only in the lung was the concentration of ^{210}Po different for smokers and nonsmokers. It was present in most samples from other parts of the body, and there was little difference between the values for the 2 groups. There was no significant relation between the lung concentration of ^{210}Po and the total number of cigarettes smoked expressed as pack years or with the age of the subjects, but there was an upward trend in those with a high daily consumption. The highest levels were found in patients who had smoked until 24 hr or less before the time of death or operation. In the lungs, the distribution of the isotope was found to be uneven, its concentration being higher in the bronchial epithelium and the overlying layer of mucus than in the parenchymal tissue, and especially high at the bifurcations of the bronchi. A smoker may expose his bronchial tree, in the course of a 25-yr smoking history, to a minimum of about 200 rem, as compared with a background level of radiation over the same period of time of about 5 rem. If the radioactivity were concentrated at hot spots, for instance, the bifurcations of the bronchi, rather than evenly spread throughout the lung, the local dose would be even higher. But whether or not such bifurcation hot spots exist, there is no doubt that cigarette smoking leads to an increased concentration of a potentially dangerous isotope in lung tissue. (BBB)

24350 DETERMINATION AND ISOTOPE-RATIO ANALYSIS OF DIFFERENT FORMS OF NITROGEN IN SOILS. 5. FIXED AMMONIUM. Silva, J. A. (Iowa State Univ., Ames); Bremner, J. M. Soil Sci. Soc. Amer., Proc., 30: 587-94(Sept.-Oct. 1966).

A new method, using analysis for ^{15}N, of determining fixed ammonium in soils is described. The soil sample is treated with alkaline KOBr solution to remove exchangeable ammonium and organic nitrogen compounds, and the residue is washed with 0.5M KCl and shaken with 5N HF : 1N HCl for 24 hr, the ammonium released by the HF–HCl treatment being determined by steam distilling the soil-acid mixture with KOH. The KOBr treatment effects almost quantitative removal of organic soil N under conditions which preclude fixation by soil minerals of ammonium released from soil organic matter by this treatment, and evaluation tests indicate that the procedure used to estimate fixed ammonium in the KOBr-pretreatment residue is satisfactory. The method is simple and precise, and has none of the observed defects of previous methods of estimating fixed ammonium in soils. (BBB)

24351 A CLINICAL TECHNIQUE USING ^{197}Hg FOR DETERMINING THE BLOOD–CEREBROSPINAL FLUID BARRIER: A PRELIMINARY REPORT. Janecek, James; Cramer, Glen; Loken, Merle K.; Koutsky, Carl D. (St. Paul-Ramsey Hospital, St. Paul). Amer. J. Psychiat., 123: 1005-7(Feb. 1967).

A new technique, employing a radioisotope, was developed for studying the blood-brain barrier, and the permeability of this barrier by this isotope was tested in human subjects. The combination of a brain scan using ^{197}Hg followed by a lumbar puncture offered a method of evaluating the blood-cerebrospinal fluid barrier. On the night preceding the brain scan, each patient received one ml of meralluride and theophylline solution (Mercuhydrin) intramuscularly. The following morning each patient was given 1 mCi of ^{197}Hg (in the form of chlormerodrin-^{197}Hg) intravenously. Then, at prescribed times a lumbar puncture was performed in the sitting position; 10 ml of cerebrospinal fluid was collected and counted in

a well scintillation counter. At times corresponding to the lumbar punctures, 5 ml of blood was withdrawn and counted. Brain scans were obtained after 4 hr, and serial scintophotograms were also obtained with a scintillation camera at varying times after the injection of the chlormerodrin-^{197}Hg. In general, there was a progressive decrease with time in the amount of ^{197}Hg in the cerebrospinal fluid. The data suggested that ^{197}Hg passes the blood-cerebrospinal fluid barrier. As indicated by this study this radioisotope technique may prove to be a valuable investigative method. (BBB)

24352 STUDIES ON THE TRANSFORMATION OF WATER IN LEAVES WITH TRITIATED WATER. II. CRITICAL STUDY OF TECHNIQUES FOR ANALYSIS AND MEASUREMENT OF RADIOACTIVITY OF WATER AND TRITIATED LEAF METABOLITES. Ferron, Francoise; Van Assche, J.; Deroche, Marie-Esther; Costes, C. (Centre National de Recherches Agronomiques, Versailles, France). Ann. Physiol. Veg., 7: 171-203(1965). (In French).

A description is given of experimental techniques necessary for the study of water metabolism in wheat leaves with tritiated water. Two major problems occur with this isotope: determination of radioactivity in various tritiated compounds by liquid scintillation, and isotopic effects, mainly isotopic exchange. Liquid scintillation techniques for counting radioactivity of ^{3}H are compared for various scintillators: their characteristics are summarized in a table. Reasons are given for preference of the phosphor (DPO, 4 g/l; POPOP, 0.1 g/l in toluene) which has the highest efficiency (4.5%). To eliminate the quenching induced by extracts of leaves, these were bleached by hydrogen peroxide and uv light. Standard techniques for the extraction of water and metabolites from tissues were developed to reduce the rate of exchange of tritium between water and hydrogen from organic molecules. This rate of exchange was determined for several metabolites (sugars, amino acids, and organic acids). In the procedures described the leaves were frozen and ground in the cold; the water extracted from the tissues was rapidly eliminated from the first extract, and the metabolites were then extracted with aqueous ethanol at room temperature in the presence of inhibitors of oxidases and phosphatases; and the water was extracted by freeze-drying from tissues of a second sample. In this way, the radioactivity of the tritium incorporated in various leaf metabolites could be compared. (BBB)

24353 STIMULATION BY ADIPHENINE OF THE UPTAKE OF RADIOACTIVE IODINE BY THE THYROID OF THE RAT. Mornex, R.; Tourniaire, J.; Falconnet, M. F.; Durand, H. (Faculte Mixte de Medecine et de Pharmacie, Lyon, France). J. Physiol. (Paris), 58: 256-7(1966). (In French).

Adiphenine (diethylaminoethyl ester of diphenylacetic acid), an antispasmotic of the atropinic type, was shown to increase the incorporation of ^{131}I in the thyroid gland. Adephenine was administered subcutaneously in a dose of 2.5 mg/day for 10 days. In the first hr the ratio between thyroid and serum activity (T/S) was increased to 436, as compared to 285 in controls. At 24 hr, the thyroid of drug-treated animals had taken up 48.4% of injected ^{131}I as compared to 16.4% in controls. It was suggested that the drug acted by stimulating the hypothalamus and thereby increased thyrotropin production. (BBB)

24354 TOXICITY OF BERYLLIUM. Aldridge, W. N. (Medical Research Council Labs., Carshalton, Eng.). Lab. Invest., 15: 176-80(Jan. 1966).

Intravenous injections of beryllium compounds into rats were very toxic and produced midzonal liver necroses. The LD_{50} was established at ~0.5 mg Be/kg body weight. Up to 30% of the injected dose was found to concentrate in the liver where the main lesion occurred. Blood beryllium apparently formed a complex with blood phosphate that was exceedingly insoluble and particulate; this complex was taken up by the Kupffer cells of the liver where ionic beryllium diffused outward and produced the lesion. The inbition of phosphoglucomutase by beryllium was examined. Inhibition of enzyme activity was not obtained without preincubation in the presence of a chelating agent, cysteine. Magnesium and a chelating agent were required for activation. Inhibition was much less pronounced in the presence of magnesium and competitive inhibition was demonstrated. However, inhibition was progressive, showed the characteristics of a bimolecular reaction with one component in excess (1st order), and had a high temperature coefficient. The irreversible inhibition of phosphoglucomutase by beryllium indicated its role in liver toxicity. In rats, 24 hours of fasting after administration of beryllium led to a higher liver glycogen level than in the controls, an unusual finding in toxic liver injury. This seemed to indicate an inhibition of phosphoglucomutase. (TSS)

24355 MODIFICATIONS OF AN ELECTRONKINETIC CHARACTER INDUCED BY THERMAL TREATMENTS COMBINED WITH THE EFFECTS OF ULTRAVIOLET RADIATIONS ON THE PROTEINS OF COW'S MILK WHEY. Ambrosino, C.; Liberatori, J.; Papa, G.; Sarra, C. (Istituto di Zootecnici Veterinaria, Turin). Minerva Pediat., 18: 762-6(Apr. 28, 1966). (In Italian).

Electrophoretic studies were conducted on proteins in milk whey exposed to various heating procedures and uv radiation. The first sample was heated rapidly in a coil to 76 to 78°C for 15 min. No appreciable changes in mobility or concentration were noted after such rapid pasteurization. Electrophoresis was conducted in Veronal-citrate buffer, pH 7.8. The second sample was irradiated with uv at 88°C for 5 to 6 min. Electrophoresis showed an increase in the least mobile fraction. In whey that was heated for 2 min at 148°C this fraction was decreased as seen in free electrophoresis. Sterilization of whey by heating to 136°C for 5 min followed by 116°C at 14 min resulted in a decrease of the most mobile components. Results of agar electrophoresis are also described. (BBB)

24356 THE INFLUENCE OF X-RADIATION, METHIONINESULPHOXIMINE, BURNS, AND CYTOSTATIC AGENT TS 160 (SPOFA) ON THE URINARY EXCRETION OF INORGANIC PHOSPHATES AND AMMONIA AND ON THE LEVEL OF ADENINE NUCLEOTIDES IN BLOOD AND LIVER OF RATS. Kolousek, J.; Jiracek, V.; Zicha, B.; Dienstbier, Z. (Charles Univ., Prague). Neoplasma, 13: 289-94(1966).

The effects of x radiation, methioninesulfoximine, the cytostatic agent TS 160-Spofa (tris-chlorethylamine hydrochloride), and of burns on the excretion of inorganic phosphates and ammonia nitrogen in the urine of rats was studied. The influence of x radiation (1000 R) and of L-methioninesulfoximine on the levels of adenine nucleotides (ATP, ADP, AMP) in liver and blood of the rats was also studied. (TSS)

24357 ROOT TRANSFER OF FISSION PRODUCTS FROM CONTAMINATED SOIL. Romney, E. M.; Nishita, H.; Olafson, J. H.; Larson, K. H. (Univ. of California, Los Angeles). Soil Sci. Soc. Amer., Proc., 27: 383-5(July-Aug. 1963).

Dry yield of wheat grown for 117 days was not affected by solutions of nuclear reactor-produced mixed fission products (MFP) applied to the soil surface or mixed with equal amounts of potted soil at contamination level ranging from 0.01 to 1.0 μCi β activity per g of soil. Concentrations of β and γ activity in the above-ground parts of plants were increased as the soil contamination levels increased. Wheat removed from 0.07 to 0.09% of the total β activity that had been mixed with the soil and from 0.10 to 0.15% of that which had been applied on to the soil surface. Concentrations of radioactivity in above-ground plant parts were highest in leaves, intermediate in stems, and lowest in fruiting heads. Radiostrontium accounted for 50 to 80% of the β activity transferred to above-ground plant parts, and about 10% was attributable to root transfer of ^{91}Y, ^{106}Ru, ^{137}Cs, and ^{144}Ce from soil. (BBB)

24358 DIRECT AND INDIRECT EFFECTS OF IONIZING RADIATIONS. Dale, W. M. (Christie Hospital, Manchester, Eng.). pp 1-38 of Handbuch der Medizinsschen Radiologie. Vol. 2, Part 1. Diethelm, L.; (and others); (eds). Berlin, Springer-Verlag, 1966.

Evidence for the validity of the 2 theories of the mode of biological action of ionizing radiations is reviewed, with 150 references. The direct (target) action theory is examined in terms of the primary physical events, sigmoidal survival curves, and estimates of target size. In this theory the essential feature is that the dissipation of energy by ionizing radiations is not homogeneous on the microscale, but is associated with tracks of ionizing particles or photoelectrons as discrete packets of ionizations. The target-theory reflects this discontinuity by assuming sensitive volumes (targets) in organized matter in which an ionizing event (frequently a single ionization) has to occur for producing an observable effect (cell death, inactivation of a virus, gene mutation, etc.). The occurrence of such an event is called a hit; and the conditions of the validity of a single hit are explained. The indirect-action theory is examined on the basis of the formation of radicals in water, the dilution effect, radioprotective agents, yield-dose relations, the oxygen effect, and model studies in polymers. (BBB)

24359 METHOD OF SPLIT SKIN AUTORADIOGRAPHY. Giacometti, Luigi; Allegra, Fulvio (Oregon Regional Primate Research Center, Beaverton). J. Invest. Dermatol., 47: 171-3 (1966).

A method was devised for studying with high resolution autoradiography the biosynthesis of DNA in split-skin preparations. The method detects ^{3}H-thymidine-labeled cells on a layer of nuclear track emulsion applied directly to the undersurface of the epidermal sheet. This method allows certain problems of cell proliferation kinetics and sites of isotope incorporation to be studied in a complete and undistorted epidermal structure. Skin was obtained from 10 adult male guinea pigs and two rhesus monkeys (Macaca mulatta). Pieces of skin (0.5 cm^2) were placed in organ culture dishes with grids and incubated for 4 hr in culture medium 199 containing 2.5 μCi/ml of ^{3}H-thymidine (sp act. 6.7 Ci/mM) at 37°C under 5% CO_2 air mixture. After incubation, the skin was

placed under a dissecting microscope and the epidermis was separated from the dermis and fixed for 3 to 4 hours in 10% formalin. Kodak NTB2 autoradiographic emulsion was used to coat the slides. This technique is simple, reproducible and has the advantage of demonstrating labeled epithelial cells in a three-dimensional view. (BBB)

24360 EFFECT OF γ RAYS ON Na^+-K^+-ATPase, AN ENZYMATIC FACTOR WHICH MEDIATES IN ACTIVE SODIUM TRANSPORT THROUGH BIOLOGICAL MEMBRANES. Asudillo, M. D.; Sanz, F.; Lopez-Zumel, C. (Instituto de Quimica Fisica, Madrid). Rev. Espan. Fisiol., 22: 115-20(1966).

The effect of radiation on transport of Na across membranes was studied in skin from Rana esculenta. To follow the kinetics of the process the Ringer solutions used were labeled with ^{22}Na. The membranes were irradiated by a ^{60}Co source with doses of 1000, 5000, 10,000, and 20,000 rads. Sodium influx diminished with increasing radiation doses, up to 10,000 rads. At 20,000 rads the flux increased and the values obtained were similar to those for 1000 rads. On the contrary, the outflux increased as the radiation dose increased, but as before, at 20,000 rads an anomaly was found and the flux was smaller than that at 10,000 rads. Activity of the ATPase changed as a function of the dose applied to the membrane, and as with the influx of Na the activity decreased with increasing radiation doses, but at 20,000 rads reached a higher value. The curve obtained paralleled that for ^{22}Na kinetics. The results suggest that there is a relation between ATPase activity and active transport of Na. (TSS)

24361 DEPLETION OF STRONTIUM FROM CALVES BY HEMODIALYSIS. Downey, H. F. (Univ. of Illinois, Urbana); Stewart, W. E.; Cragle, R. G. Trans. Amer. Soc. Artif. Intern. Organs, 10: 350-2(1964).

The 3 treatments given were the intravenous administration of 0.25 mCi of ^{85}Sr at 4, 14, and 24 hr before the start of a 12-hr dialysis with the Kolff twin-coil artificial kidney. Each treatment was replicated 3 times on 3 different 200-lb, 100-day-old male or female calves, fasted 27 hr before dialysis. These animals are similar to humans in size and blood volume. To determine how much the natural excretion decontamination processes would be aided by hemodialysis, each calf was given ^{85}Sr intravenously followed in 10 days by ^{85}Sr. Fecal and urine losses were compared for 7 days; 4 hr after ^{85}Sr was given the calves underwent hemodialysis for 12 hr. (TSS)

24362 INHIBITION OF THE ACTIVE TRANSPORT OF SUGARS BY X IRRADIATION IN VITRO OF INTESTINAL SACS. Nadal, J.; Ponz, F. (Univ. of Barcelona). Rev. Espan. Fisiol., 22: 105-8(1966).

The effect of 1580-, 3000-, 10,000-, and 20,000-R doses of x rays on transport of sugars was studied in vitro in rat jejunum. Active transport of sugars was expressed in terms of the gradients of serosal (S) and mucosal (M) concentrations obtained at the end of the experiment. The expression (S−M)M was used to indicate the preferential passage of sugar in the mucosal → serosal direction. Irradiation of jejunum sacs with 1580 to 10,000 R did not affect galactose transport, but its active transport was inhibited approx 45% by 20,000 R. Addition of 0.1M cysteamine to the medium did not alter galactose transport; therefore, 0.02M concentrations of this radioprotective agent were tested. At this level cysteamine was only partially effective, reducing the inhibitory effect of 20,000-R irradiation on galactose transport from 44% to 30%. The lack of protection by cysteamine is attributed to its failure to enter the cells. (BBB)

24363 AN ATTEMPT OF REMOVAL OF RADIOACTIVE STRONTIUM (^{85}Sr) DEPOSITED IN THE BONE BY MEANS OF PARATHYROID HORMONE AND A CHELATING AGENT: A RADIOLOGICAL AND PATHOLOGICAL STUDY. Takeuchi, Tadashi; Seki, Masatoshi; Takagi, Chiyoji; Enomoto, Yoshikazu; Matsuo, Yuji; Kantake, Naoshi; Mashimo, Tadadshi; Ishimochi, Ryoji; Yoneyama, Tatsuo (National Inst. of Radiological Sciences, Chiba, Japan). Acta Pathol. Jap., 14: 405-12(Nov. 1964).

Six μCi of ^{85}Sr in the form of the nitrate was injected into Wistar rats intraperitoneally. About 7 weeks after the injection of ^{85}Sr, parathyroid hormone (PTH) and citrate, as a chelating agent, were administered in various doses at appropriate intervals. The chelating solution was a mixture of 10% sodium citrate and 2% $CaCl_2$ solutions with a ratio of 1:2. From counts of the radioactivity of ^{85}Sr in the urine, it was evident that the urinary output of ^{85}Sr increased temporarily with a peak between 24 to 48 hr after PTH injection. The most effective method so far obtained for removal of ^{85}Sr was administration of 200 units of PTH, followed by citrate. The increase of ^{85}Sr excretion by a combination of PTH and chelating agent was about 1600 cpm per treatment. Since 130,000 cpm of ^{85}Sr remained in the body of control rats until the end of the experiment, this is not a very large proportion of the retained radiostrontium. Histologically, the parathyroids showed a slight tendency toward glandular formation. The bone trabeculae showed moderate thinning. The causes of appearance of hyaline casts in the Henle's loops and distal convoluted tubules and of lymphocytic interstitial nephritis were discussed in terms of the physiological action of PTH. (BBB)

24364 THE EFFECT OF URANYL NITRATE ON INTESTINAL TRANSFER OF HEXOSES. Newey, H.; Sanford, P. A.; Smyth, D. H. (Univ. of Sheffield, Eng.). J. Physiol. (London), 186: 493-502(1966).

Uranyl nitrate depending on the concentration was found to exert various effects on sugar absorption, the nature of the hexose present, and the initial location of the hexose. At a concentration of 3×10^{-4}M it reduced mucosal transfer of glucose but not of galactose nor 3-O-methyl-glucose by sacs of everted rat intestine. At this concentration uranyl nitrate had little effect on glucose metabolism, as measured by glucose disappearance. Uranyl nitrate at a concentration of 3×10^{-3}M reduced transfer of glucose, galactose, 3-O-methyl-glucose, and fluid. Glucose metabolism was also inhibited. Uranyl nitrate did not inhibit entry of glucose into the intestine under anaerobic conditions. Glucose was inhibited or galactose transfer was stimulated depending on the conditions. The inhibitory action was presumably by competition for a common carrier, whereas stimulation indicated that glucose metabolism supplied energy for galactose transfer. It was suggested that there were two different routes for glucose in the cell, one being uranyl sensitive and not used by galactose, and the other, uranyl insensitive and shared by both hexoses. (BBB)

24365 THE INFLUENCE OF IONIZING RADIATION ON SOME PATHWAYS OF METABOLIC PROCESSES IN PARAMECIA. Kovaleva, N. E. (Inst. of Cytology, Leningrad). Tsitologiya, 8: 629-38(Sept.-Oct. 1966). (In Russian).

Paramecium caudatum were irradiated with 75 kR of x rays. The sensitivity of the ciliates to some inhibitors (KCN, malonate, 2,3-dinitrophenol, and monoiodoacetic acid) was studied to reveal changes occurring in metabolic processes. The sensitivity to the inhibitors of respiration and oxidative phosphorylation was found to rise considerably, while the sensitivity to the inhibitor of glycolysis was shown to reduce compared with corresponding indices in the unirradiated infusoria. The data obtained have indicated that it is the aerobic glycolysis which predominates in the metabolic processes of the irradiated infusoria. Aerobic glycolysis in the irradiated infusoria becomes so active that a much longer treatment with monoiodoacetate (1×10^{-5} M) is required compared with the unirradiated ones. (auth)

24366 EARLY PERMEABILITY CHANGES IN WHOLE-BODY X-IRRADIATED RATS. Harris, John Wayne. Rochester, N. Y., Univ. of Rochester, 1965. 146p.

Thesis.

There is considerable evidence that the vascular permeability changes evoked by many different types of local insults follow a typically biphasic time course. With the single exception of x irradiation, this time course has been shown to be similar for a wide range of agents. The relationship of x irradiation to these other agents. The relationship of x irradiation to these other agents, however, is obscure; only a few studies have been designed to investigate this aspect of radiation damage. Although there have been many qualitative studies of the events of the early post-irradiation period, only a minimal amount of quantitative data is available; results from studies with whole body irradiated animals are particularly lacking. It was felt that a quantitative investigation of the early vascular response to whole body x-irradiation should be undertaken in a system which would permit the separation and measurement of the various components of the early response (protein, fluid, and cellular). The system chosen for this study was the vascular/peritoneal cavity circuit of the rat. At intervals after 750 R or 1500 R whole body x irradiation (250 KVP), or sham irradiation, female rats (120 to 160 grams) were injected intravenously with I-131 labeled rat albumin. Thirty minutes post-injection the animals were sacrificed and plasma and peritoneal fluid radioactivity measured. This test was performed at several times between 2 and 48 hours postirradiation. The movement of labeled albumin into peritoneal fluid increased after irradiation; the pattern of this increase was, (at least after 750 R), clearly biphasic over the period studied (48 hours). The first rise, significant by 3 hours (750 R) or 4 hours (1500 R), reached levels 62% and 80% above control for the two doses, respectively. These levels were maintained for at least 4 hours, the 750 R curve returning to normal after this time. There were no statistically significant differences between the two curves for the first 8.5 hours post-exposure. Although net albumin transfer had returned to normal 12 hours after 750 R, this parameter remained significantly elevated in animals exposed to 1500 R. Both groups showed evidence of a second rise at 24 hours and at the

last time examined (48 hours), the figures were 79% (750 R) and 230% (1500 R) above controls. There was no decrease in albumin clearance from the peritoneal cavity of irradiated rats during the first period of protein influx into the cavity (5 to 5.5 hours). Studies in noninjected rats showed increased peritoneal fluid volume and peritoneal leucocytosis (due to influx of small mononuclear cells) during the first of the two peaks (4 to 6 hours); no influx of neutrophils into the cavity was observed. There was an early leucocytosis in the blood of irradiated rats, but hematocrits were unchanged during the first 12 hours. The latter observation was taken as evidence that no marked changes in plasma volume had occurred during this time. The blood leucocytosis had subsided before peritoneal leucocytosis was observed. An attempt was made to relate the first increase of net albumin transfer noted in this work to one of the two peaks of increased vascular permeability which characterize the typical inflammatory response evoked by other agents. For this purpose, rats were given intravenous injections of an anti-histamine (pyrilamine maleate) just prior to irradiation or sham irradiation and tested for net albumin transfer 5 to 5.5 hours later. This agent failed to affect the increased albumin leakage observed in animals exposed to 750 R. Full evaluation of this result awaits the completion of further experiments. (Dissertation Abstr.)

24367 STRUCTURAL DEFECTS IN DNA AND THEIR REPAIR IN MICROORGANISMS. Proceedings of a Conference on Radiation Microbiology Held at the University of Chicago, Chicago, Illinois, October 18–20, 1965. Haynes, Robert H.; Wolff, Sheldon; Till, James (eds.). Radiat. Res., Suppl. No. 6, 1-243(1966). (CONF-651084).

Separate abstracts have been prepared for 10 of the 19 papers presented at the conference. (W.E.B.)

For abstracts of individual papers see: 24368–24372, 24379, 24380, and 24675–24677.

24368 INTERPRETATION OF MICROBIAL INACTIVATION AND RECOVERY PHENOMENA. Haynes, Robert H. (Univ. of California, Berkeley). Radiat. Res., Suppl. No. 6, 1-29(1966).

Reproductive death in bacteria treated with x rays, ultraviolet light, or nitrogen mustard arises primarily from the formation of structural defects in DNA which serve to block normal DNA replication. In many cells, viability is enhanced through the action of certain enzymic processes that repair these defects before the onset of replication. Thus, in the analysis of dose-response curves, survival is determined jointly by the nature and distribution of the initial DNA defects and the probability of their subsequent repair. The apparent radiosensitivity of cells can be increased either by altering the physicochemical reactions involved in the formation of the defects or by interfering with the biochemical repair processes. Sensitization by interference with repair appears to be involved in at least three well-known radiobiological effects: the existence of shoulders on survival curves; the synergistic interactions that occur among uv, x rays, and nitrogen mustard; and radiosensitization by agents that either bind or are incorporated into DNA (for example, acridine dyes and halogenated base analogs, respectively). Since repair is an enzymic, energy-requiring process, it can be attenuated by excessive DNA substrate damage, by direct attack on the repair enzymes, or by blockage of its energy supply. In general, it is difficult to distinguish among these three alternatives. Repair of uv damage in E. coli B/r is a multistep process involving nuclease excision of defective single-strand segments containing pyrimidine dimers, and a nonconservative mode of DNA replication which fills in the resulting gaps. Similarities in the relative sensitivities of E. coli B/r, B, and B_{s-1} to uv and nitrogen mustard, the involvement of nucleases in repair, and the observation of repair replication after both uv and nitrogen mustard treatment lend strong support to the idea that it is not the damaged bases themselves that are recognized by the repair enzymes, but rather the associated secondary structural alterations in the phosphodiester backbone. Thus, repair might be of general biological significance in the maintenance of genetic stability by detecting and repairing a variety of possible distortions or defects in the Watson-Crick structure. The selective advantage arising from the possibility of repair inherent in the complementary structure of DNA might account for the ubiquity of double-stranded nucleic acid molecules as the genetic material of living cells. (auth)

24369 PHYSICAL AND CHEMICAL CHANGES INDUCED IN NUCLEIC ACIDS BY ULTRAVIOLET LIGHT. Smith, Kendric C. (Stanford Univ., Calif.). Radiat. Res., Suppl. No. 6, 54-79(1966).

The nature and possible biological importance of photochemical events in the carbohydrate and purine residues of the nucleic acids are unknown. Pyrimidine hydrates do not seem to be formed in double-stranded molecules but are formed in single-stranded regions. The possible importance of hydrates in causing mutations has been demonstrated. Cyclobutane-type dimers are formed by all the pyrimidines, separately and as mixed dimers. The biological importance of this type of dimer has been documented. This type of photoproduct is not formed in DNA under all conditions, so it cannot occupy a position of supreme biological importance in all situations. Other types of photoproducts must therefore also be of biological importance. Ultraviolet irradiation breaks hydrogen bonds and causes chain breakage, but the biological importance of these lesions is not well evaluated. The chemical nature and biological importance of intermolecular cross-linking and intramolecular–interstrand cross-linking are not known. The biological importance of DNA–protein cross-linking at low doses of uv has been indicated, but the precise chemical mechanisms involved are not known. In vitro results suggest that this cross-linking may involve the attachment of amino acid residues through their SH (or OH) groups to the 5 (or 6) carbon of cytosine. The intrinsic sensitivity of DNA can be affected by a change in base composition, by substitution by analogs, and by altering the environment and physical state of the DNA during irradiation. Very few papers have been published on the photochemistry of RNA. The photochemistry of the nucleic acids bids to remain a very exciting area for research for many years to come. (auth)

24370 LETHAL CHANGES IN BACTERIOPHAGE DNA PRODUCED BY X RAYS. Freifelder, David (Univ. of California, Berkeley). Radiat. Res., Suppl. No. 6, 80-96(1966).

From numerous experiments, constants have been measured. However, the virtue of the centrifugal analysis of the phage system is that all doses used were in the biological range, numerical conclusions are probably accurate to the 5 to 10% level, and all experiments have been carried out with a single organism. It is unfortunate that the centrifuge technique cannot be applied to higher organisms; this must await development of procedures for isolating pure, unbroken DNA in quantity. Phages suspended in buffer are inactivated by x rays by the production of double-strand breaks in the DNA; phages in media which protect against ionizations occurring external to the phage particle are inactivated by both double-strand breakage (30 to 40%) and presumably by base damage; the acquisition of single-strand breaks is not lethal; sensitization by a 5-BU substitution does not occur via an effect on strand breakage; and the principal base damage may be to thymine. (auth)

24371 MUTAGENIC AND INACTIVATING DNA ALTERATIONS. Freese, Ernst; Freese, Elisabeth Bautz (National Inst. of Health, Bethesda, Md.). Radiat. Res., Suppl. No. 6, 97-140(1966).

Primary chemical alterations of nucleic acids can be classified into nonhereditary, mutagenic, and inactivating alterations. Unless enzymes affect the altered nucleic acid, nonhereditary alterations neither block its synthesis nor induce mutations, mutagenic alterations do not intercept nucleic acid synthesis but efficiently induce mutations, whereas inactivating alterations do block nucleic acid synthesis and occasionally induce mutations. As a consequence of these primary alterations, different final DNA alterations can be produced which may be lethal, be mutagenic, or have no phenotypic effect on the organism. This paper surveys the primary nucleic acid alterations, which can be induced by different agents, and analyzes their genetic and phenotypic consequences. It shows in particular that inactivating DNA alterations, in contrast to mutagenic DNA alterations, produce only few mutations per lethal hit. Finally, the significance of inactivating DNA alterations is discussed with respect to the production of pure mutant clones, the increase of recombination, the induction of lysogenic bacteria, and the induction of cancer. (auth)

24372 DNA REPAIR AND GENETIC RECOMBINATION: STUDIES ON MUTANTS OF ESCHERICHIA COLI DEFECTIVE IN THESE PROCESSES. Howard-Flanders, Paul; Boyce, Richard P. (Yale Univ., New Haven). Radiat. Res., Suppl. No. 6, 156-84(1966).

Radiosensitive mutants have been obtained from a genetically marked radiation-resistant strain of E. coli K-12 after treatment with a mutagen. The sites of mutation have been mapped by crossing with suitable mating strains. The nature of the defects has also been investigated by following the metabolism of DNA in these strains after irradiation or treatment with other mutagenic agents. The principal types of mutant investigated are described. The repair of DNA in cells is thought to occur following treatment with various mutagenic agents including x rays, uv light, mitomycin C, mono- and difunctional alkylating agents, and nitrous acid. In each case, repair is thought to involve local single-strand breakdown and repair synthesis. The repair of uv-induced pyrimidine dimers in DNA is initiated by their release in an oligonucleotide by enzymes controlled by three uvr genes in E. coli K-12. There is suggestive evidence that bases in DNA reacted by difunctional alkylating agents, mitomycin C, and nitrous acid may also be excised as a first stage in repair. DNA containing x-ray products also appears to be repaired by the mechanism involving DNA breakdown and repair synthesis, although the excision process con-

trolled by the uvr genes plays only a minor role in this repair. (TCO)

Ecology

Refer also to abstract 24660.

24373 RADIATION AND THE PATTERNS OF NATURE. Woodwell, George M. (Brookhaven National Lab., Upton, N. Y.). Science, 156: 461-70(Apr. 28, 1967). (BNL-10318).

Introductory discussions of natural communities and successions are presented. It is pointed out that a sudden drastic change in the environment, such as fallout from a bomb, causes changes in the succession to be just the reverse of those occurring during a normal succession. Studies were conducted on the patterns of radiation effects on the structure, function, and development of natural communities. In order to study the effects of ionizing radiation on communities along a successional gradient, a gradient of exposures from very high to very low was used. A single large source of gamma radiation was used to study radiation effects on an old field on Long Island. The most conspicuous change in the early stages of succession was drastic simplification; a reduction in numbers of species per unit area occurred. Six months after installation of a gamma source in a forest, five zones were apparent along the radiation gradient: a central zone in which no higher plants survived; a sedge zone containing Carex pennsylvanica and a few sprouts of the heath shrub layer; a shrub zone where two blueberries and huckleberry survived; an oak forest zone at daily exposures less than 40 R; and the oak-pine forest in which radiation effects on growth were apparent without change in species composition. Plants with large chromosomes were more sensitive to radiation damage than those with small chromosomes. Radiosensitivity and radioinduced mutations in plants are discussed. (H.L.W.)

24374 ^{65}Zn UPTAKE IN A TWO-STEP MARINE FOOD CHAIN. Regnier, John Edward. Gainesville, Fla., Univ. of Florida, 1965. 175p.

Thesis.

A laboratory food chain study was conducted to measure the values of the parameters used to calculate the Maximum Permissible Concentration of zinc-65 in sea water. The food chain consisted of two microscopic marine algae, Nitzschia closterium and Carteria sp., and the bottom feeding fish, mullet (genus Mugil). The parameters evaluated were the rates of biological elimination of zinc by mullet, and the maximum concentrations of zinc-65 accumulated by the algae and mullet as a result of chronic exposure to this nuclide. The algae concentration factors (uc per gm algae/uc per ml culture medium) were slightly greater for Carteria sp. than for Nitzschia closterium, the respective average values being 15,900 and 13,200. However, results indicated that the magnitude of these factors was limited by available zinc-65 rather than species characteristics. Mullet uptake of zinc-65 from the algae was describable by a mathematical model, and the apparent maximum concentrations were reached in 55 to 60 days. These maximums decreased in magnitude as mullet size increased. For comparable size fish, the maximum mullet concentration factors relative to the algae culture medium were 230 for Carteria-fed fish compared to 135 for those fed Nitzschia cells. The magnitude of these factors indicates discrimination rather than concentration of zinc-65 by the mullet compared to the algae zinc-65 concentration. Differences in maximum uptakes of zinc-65 from the two algae were significant, but these differences were attributed to variation in zinc-65 and total zinc concentrations in the fish food rather than to differences in the mode of uptake from the two species of algae. Biological half-lives, which define elimination rates and affect maximum uptake values, varied from 33 days to 99 days depending on the method of measurement. Mullet were found to have value as indicators of zinc-65 contamination of marine environments, and efficient monitoring programs could be designed on the basis of this property. The Maximum Permissible Concentration of zinc-65 in sea water based on the results of this study would be approximately five times greater than the current recommended value of 7×10^{-9} uc/ml. However, similar evaluations of additional marine food chains are necessary before recommendations are made to raise the existing value. (Dissertation Abstr.)

Genetics and Cytogenetics

Refer also to abstracts 24608 and 24663.

24375 (EUR-3266.I) STUDIO DEL MECCANISMO D'AZIONE DELLE RADIAZIONI IONIZZANTI ED ULTRAVIOLETTE NELLE CELLULE DI MAMMIFERO IN COLTURE IN VITRO. Relazione Annuale 1.11.64-31.10.65. (Study of the Action Mechanism of Ionizing and Ultraviolet Radiations in Vitro Cultures of Mammalian Cells. Annual Report, November 1, 1964-October 31, 1965). (Rome Univ. (Italy). Istituto di Genetica). 1967. 20p. (In Italian). Dep. mn.

After a short initial period of reorganization the main work of the research group in the year November 1964-October 1965 was devoted to the solution of the following problems: Preparation of the apparatus for uv irradiation of cells and relative dosimetry; Determination of the chromosome and growth characteristics (relative length of the various phases of the cellular cycle) of the strains to be used in the experiments; Analysis of the survival of cells irradiated with various doses and various wavelengths of uv light; Frequency and type of chromosome aberrations induced in cells irradiated with various doses and various wavelengths of uv light. In addition, and again as part of the study of the effects of uv irradiation of mammal cells, certain experiments have been undertaken to determine the following: The possibility of inducing chromosome ruptures in cells pretreated with a furocoumarin (8-methoxypsoralen) and subsequently irradiated with uv of 3650 Å. (auth)

24376 (NIRS-5, pp 47-55) GENETICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported on the following studies: two types of radiation-sensitive mutants in yeast; radioprotective effect of methylene blue in toad embryos; effective population size with overlapping generations; effective population size when fertility is inherited; effects of restricted population size and increase in mutation rate on the genetic variation of quantitative characters; ultracentrifuge experiment on uv-irradiated λ bacteriophage; effects of x rays on genetic load in a Drosophila population; heterozygous effects of newly arising spontaneous lethal genes on viability in Drosophila melanogaster; effects of toyomycin on x ray induced recessive lethal mutation rates in Drosophila melanogaster; the effect of chronic radiation on sex-linked lethal mutation frequencies in Drosophila melanogaster. (H.L.W.)

24377 DEVELOPMENTAL PHYSIOLOGY STUDIES ON THE RADIOINDUCED PROTONEMA MUTANT OF FUNARIA HYGROMETRICA SIBTH. Hatanaka-Ernst, Margrit (Univ., Freiburg i. B.). Z. Pflanzenphysiol., 55: 259-77(Aug. 1966). (In German).

The reaction of some x-ray-induced mutants of the moss to various environmental conditions including treatment with auxin (indoleacetic acid, IAA), was studied. Two mutants, Fu 194 and Fu 219, were induced by 40-kR x irradiation of spores, and 4 (Fu 272, Fu 284, Fu 304/1, and Fu 304/8) resulted from treatment of spores with 60-kR doses. In Fu 304/1 assimilation is disturbed and therefore no buds are initiated. If 2% glucose is added to the nutrient medium, bud formation will occur. In Fu 272 assimilation is increased and as a consequence the protonema shows a cushion-like appearance. The normal turf-like growth is resumed under the influence of IAA and sodium fluoride as well as by lack of light and nutrient salts. In Fu 219 formation of growth substances is disturbed, so that the mutant remains permanently in the protonema stage. Addition of IAA induces the formation of buds and the development of stems. Fu 194 is characterized by very thin and fading protonema, brownish in the center of the culture. After about 25 months all the cultures, independently of each other, switched over to another growth habit: they formed a darker and denser turf of protonema, which was designed 194/N. Higher intensity of light increases the formation of the new type of growth, whereas IAA favors the former type of growth, presumably by interaction with a certain substance, the accumulation of which causes the dense type of growth. This process of accumulation is promoted by high doses of light. Fu 304/8 also suffers from an overdosage of growth substances, because it shows all the deviations which can be exerted by IAA. Fu 284 will grow continuously as a protonema; no further development could be initiated by any experimental treatment. (BBB)

24378 INTRODUCTION OF MUTATIONS IN BARLEY POLLEN BY ULTRAVIOLET AND X RAYS. Lundqvist, Udda (Univ. of Lund, Sweden). pp 92-5 of Barley Genetics I. Proc. First Intern. Barley Genetics Sympos., Wageningen, 1963. Wageningen, Netherlands, Center for Agricultural Publication and Documentation, 1964.

Pollen in the spikes of the Svalöf variety Bonus was irradiated with x-ray doses ranging from 400 to 8000 R and used for pollination of emasculated spikes. For uv irradiation, pollen from shedding anthers was treated with a Westinghouse Sterilamp (80% emission at 2537 Å). Pollen germination tests and test crosses with the recessive marker ert a^{23} revealed that pollen irradiated with doses of x rays above 1600 R gave no viable seeds. Whereas x rays induced considerable sterility, no significant decrease in the fertility of the F_1X_1 plants was noted after uv irradiation, indicating that in barley pollen, uv is very inefficient in the production of chromosomal aberrations as compared to x rays. The spontaneous muta-

tion rate for chlorophyll mutants was 0.7%. With uv treatment the average rate was increased to 4% and with x rays to 5%. About 1% viable mutations were found with uv irradiation and 3% with x rays. These included erectoides, eceriferum, lax-eared, scirpoid, early, dwarf, intermedium, 6-row and naked kernel mutants. Also a mutant with onion-like leaves was isolated from an x-ray series. About 40 to 60% of the lethal chlorophyll mutants could be verified in the F_2X_3 generation, a percentage comparable to that found after seed treatments. All uv-induced viable mutants could be verified in F_2X_3. About 2% semisterile plants were obtained after uv and 17% after x-ray treatments. From these semisterile plants tested for translocations, 2 uv-induced and 66 x-ray-induced translocations could be isolated. Thus uv can induce translocations in barley pollen, but this mutagen is very inefficient for the isolation of translocations in comparison with x rays. The generative nuclei of the pollen grain with induced translocations gave rise to nonchimerical plants heterozygous for the translocation. The chimerical nature of the F_1X_1 plants carrying a pollen-induced chlorophyll mutation is discussed. (BBB)

24379 EFFECT OF IONIZING RADIATION ON GENETIC TRANSCRIPTION: ASPECTS OF THE MECHANISM. Pollard, Ernest C.; Barone, Thomas F. (Pennsylvania State Univ., University Park). Radiat. Res., Suppl. No. 6, 194-200(1966).

The action of ionizing radiation on genetic transcription in cells of E. coli is shown to be of two kinds. One, due to direct radiation effects on the cells, causes a reduction in transcription in a manner related to DNA degradation. This type of action does not affect messenger RNA expression. The other, due to hydrogen peroxide in the medium, causes a halt in transcription, followed by a recovery and a destruction of messenger RNA expression. (auth)

24380 MUTATION AND THE REPAIR OF RADIATION DAMAGE IN BACTERIA. Witkin, Evelyn M. (State Univ. of New York, Brooklyn). Radiat. Res., Suppl. No. 6, 30-53(1966).

Certain conclusions about uv mutagenesis can be reached with reasonable certainty; others must be qualified. The overall view that seems best to fit the facts at the present time is summarized. There is probably no real distinction between lethal and mutagenic uv photoproducts. A bacterium survives irradiation if the residual damage (after repair) does not exceed a certain strain-specific limit still compatible with DNA replication, and at least one DNA strand is free of induced lethal mutations. Such a cell will produce at least one viable segregant. An induced mutation in a particular gene will be obtained from such a survivor if an unrepaired uv lesion happens to be located in the gene in question, and if it causes a replication error during DNA synthesis. Even uv photoproducts that do not block DNA replication could contribute to lethality by causing lethal mutations in both strands of DNA. Premutational uv lesions produced at low doses (below 100 ergs/mm^2) are almost all repaired, in uv-resistant strains, by a process that includes excision. Pyrimidine dimers are involved in the induction of most of the str-r and su$^+$ mutations obtained in the sensitive strain at low uv doses. The direct photoreversibility of these mutations establishes that pyrimidine dimers are necessary, but not necessarily sufficient, prerequisites of mutagenesis. Thus, a pyrimidine dimer alone might cause a mutation, or it might do so only in some more or less complex interaction with another uv lesion. The nonphotoreversibility of lac$^-$ mutations indicate that enzymically monomerizable pyrimidine dimers do not participate in their induction. The relative amount of uv damage normally repaired in the dark, by a process that includes excision, is not the same in different regions of the DNA. For some mutations (str-r), the fraction of the premutational damage that is not normally repaired in uv-resistant strains at higher doses (around 1000 ergs/mm^2), and that therefore produces observable mutations, also includes pyrimidine dimers. For certain suppressor mutations, however, this fraction is unique in several ways, and does not appear to include "orthodox" pyrimidine dimer as a major component. The presence of a unique fraction of uv damage in genes where suppressor mutations arise suggests that such genes where suppressor mutations arise suggests that such genes (which probably code transfer RNA's, ribosomes, or other elements of translation) may contain unusual bases or base sequences, thus giving rise to unique uv photoproducts. Alternatively, their singularity may depend on an unusual physical state of the DNA in the region of these loci, such that its repairability differs from that of other regions. Mutation frequency decline involves the excision of the unique fraction of the premutational uv damage produced at the suppressor loci. Inhibition of protein synthesis after uv promotes MFD by favoring the binding of excision enzyme by the unique fraction, in competition with pyrimidine dimer. Most uv-induced mutations probably originate through replication errors due to unrepaired uv damage present in the DNA, rather than as errors in repair. Repair involving excision is not primarily responsible for the absence of mutational segregation in bacteria. (auth)

24381 TWO APPLICATIONS OF RADIOISOTOPES IN MUTAGENESIS. Moutschen, J.; Moutschen-Dahmen, M. (Univ., Liege). Mededel. Landbouwhogeschool Opzoekingssta. Staat Gent, 30: 977-89(1965). (In French).

A method for inducing mutations in plants by using a combination of chemical agents and ionizing radiation as a radioisotope-labeled mutagenic compound is proposed. It was suggested that alkylating agents labeled with ^{35}S, ^{131}I, ^{32}P, ^{14}C, or ^{3}H could be profitably used in horticulture mutation breeding. To this end, a study was made of the metabolism and intracellular localization of two such tritiated alkylating agents with sulfonate groups, namely Myleran and ethyl methane sulfonate (EMS). Myleran was labeled with ^3H in the butane portion of the molecule to give a sp act. of 105 mCi/mmole and EMS in the ethyl portion to give a sp act. of 0.7 C/mmole. Studies were conducted in dry seeds, germinating seeds, and roots of Vicia. Autoradiography revealed that ^3H-Myleran interacted with chromatin in various mitotic phases; little was found in cytoplasm and chloroplasts. Most chromosome breaks were not preferential sites of ^3H-Myleran localization. The association of ^3H-EMS with chromatin was less intense than with ^3H-Myleran. A significant increase of chromosome aberrations was noted with both ^3H-labeled agents. (BBB)

24382 EFFECT OF THE IRRADIATION OF DIFFERENT STAGES IN MICROSPOROGENESIS ON CHIASMA FREQUENCY. Lawrence, C. W. (Atomic Energy Research Establishment, Wantage, Eng.). Heredity, 16: 83-9(Feb. 1961).

The effect of chiasma frequency of the irradiation of different developmental stages in microsporogenesis was examined so that the mechanisms underlying the formation of chiasmata might be clarified. For microsporogenesis of Lilium longiflorum, responses to 30-rad ^{60}Co γ radiation were found at three different and relatively short stages: just prior to the start of meiosis, early pachytene, and late diplotene. The response at the last of these stages was interpreted as arising from a failure of terminalization, while the responses at the other two stages were taken to be true changes in crossing over. It is suggested that the first response is due to an effect on DNA synthesis, while the second is due to a more direct effect on the mechanism of chiasma formation. The data support the generally accepted view that chiasma formation takes place during pachytene. (TSS)

24383 MEIOTIC ANALYSES OF VITAL MUTANTS RADIO-INDUCED IN CAPPELLI DURUM WHEAT. Martini, G. (Univ., Pisa, Italy). Genet. Agr., 18: 174-82(1964). (In Italian).

Viable morphological and chlorophyll mutants of Triticum durum of Cappelli variety, obtained after treatment of caryopses by thermal neutrons and x rays, were analyzed cytologically at meiosis in pollen mother cells. Only three progenies (about 27%) among 11 analyzed in R_3 showed chromosomal translocations. Analysis was conducted also in R_4 by examining five previously studied progenies and other new progenies; R_4 individuals and F_1 individuals obtained by crossing single mutants (R_4) to the original line Cappelli were studied. The frequency of R_4 progenies bearing translocations was low (about 28%). Among 33 analyzed F_1 progenies, 19 (57.58%) showed reciprocal translocations (ring of four at meiosis), while the remaining 14 progenies were normal. Among progenies showing translocations, 36.36% were considered as derived from individuals which were probably homozygous for the structural change, since every F_1 plant analyzed was heterozygous for translocations. No appreciable difference existed between frequencies of translocations in individuals from progenies treated by thermal neutrons and those treated by x rays (48.38% and 47.62% respectively). Thus, cytogenetic analysis of 52 mutant progenies, each coming from a single R_1 individual, showed that 48% of them carried nonlethal chromosome mutations, i.e., reciprocal translocations. (BBB)

24384 LINKAGE STUDIES IN PISUM. V. THE MUTANT ALBINA$_{R2}$. Blixt, Stig (Plant Breeding Inst., Weibullsohm, Sweden). Agri Hort. Genet., 24: 168-72(1966).

The mutant albina$_{R2}$ (line 5105) was developed by x-ray treatment of the pea variety Parvus with a 15 krad dose. The mutant is very small, early withering type; the leaves are white but stalks in the soil surface are greenish. The mutant is not viable, and segregates mostly with a great deficit of the homozygous recessive mutants. In X_2, the mutant segregated out 12 normal plants to 2 albina plants. The heterozygotes were saved, and in X_3 to X_5 a total segregation of 286 normal : 33 albina plants was observed. The results of the cross B 250, line 5105 X line 1072, in which the linkage of the albina$_{R2}$ mutant was studied, are reported. A weak linkage with the gene U in chromosome V was found, but further investigations are necessary to verify the localization of this albina gene in chromosome V. As no previous case of albina has been investigated, the gene determining the mutation albina$_{R2}$ was given the symbol alb. (BBB)

24385 LINKAGE STUDIES IN PISUM. VI. THE LUTEO-MACULATA MUTANT. Blixt, Stig (Plant Breeding Inst., Weibullsholm, Sweden). Agri Hort. Genet., 24: 173-92(1966).

The mutant luteo-maculata$_{R3}$ line 5314 was developed by x-ray treatment of the pea variety W.709, with 6 krad. The mutant was characterized by spots or sectors of a yellowish color on leaves and stipules. Two other luteo-maculata lines were also developed. Line 5263, luteo-maculata$_{S2}$, originated from the variety Witham Wonder as a spontaneous mutant. Line 5095, luteo-maculata$_{R2}$, resulted from x-ray treatment of the variety Witham Wonder with 4 krad. This mutant was variable in its manifestation, most plants having the yellow sectors characteristic of the luteo-maculata type, though entirely yellow or green plants occurred. Four crosses, B 254, line 5263 × line 1072; B 267 and 283, line 5314 × line 1072 and 851 respectively; and B 286, line 5095 × line 1072, were studied with respect to the linkage of the genes controlling the luteo-maculata mutations carried by the lines 5263, 5314, and 5095. The luteo-maculata mutations were found to segregate in F_2 in a ratio of 15 normal : 1 luteo-maculata, and the F_3 generation gave 3 : 1 as well as 15 : 1 segregating families in ratios that deviated no farther from expectation than could be accounted for by the lesser viability of the mutant. This demonstrated that the luteo-maculata mutations in question were controlled by 2 recessive genes. In line 5263, one of the luteo-maculata genes was weakly linked with R in chromosome VII and the other with A and Gri in chromosome I. In line 5314 linkage was found between one luteo-maculata gene and several genes in chromosome IV. In line 5092 one gene was linked with Le and probably Pro in chromosome IV and the other with R in VII. The frequency of the maculata mutations and the possibility of an affinity of the luteo-maculata genes with a certain chromosome were discussed. (BBB)

24386 INDUCTION OF VARIATION IN A BEAN POPULATION BY A COMBINATION OF RECURRENT INTER-CROSSING AND NEUTRON IRRADIATION: CYCLES ONE AND TWO. Pinchinat, A. (Centro de Ensenanza e Investigacion, Turrialba, Costa Rica); Adams, M. W. U. S. Dept. Agr., ARS74-32: 30-1 (July 1965).

This study was designed to determine whether a plant breeder could work within an already highly selected or elite population and create useful variability for selection purposes. Data were obtained on mean squares among randomly selected progeny rows within lines in the F_4 generation following none (P), one ($1C_1$), or two ($1C_2$) generations of intercrossing, where the parental generation consisted of 150 bean progenies tracing to 10 original homozygous parental lines, the $1C_1$ consisted of 450 progenies tracing to 45 single crosses involving the 10 parents, and $1C_2$ consisted of 1780 progenies tracing to 178 lines produced by intercrossing the 45 single crosses. For comparison, a parallel set of nonirradiated lines (control) and neutron-irradiated lines was grown. For pods per plant, intercrossing reduced the variability slightly, whereas radiation had a small enhancing effect, suggesting that intercrossing tends to break coupling linkages, and that radiation is slightly mutagenic, tending to contribute to increase in variance. This is supported by the increase in variance of the irradiated parental progenies. For seeds per pod, both radiation and intercrossing enhanced variance. With respect to weight per 100 seeds, intercrossing increased variance as expected in the nonirradiated population and in the irradiated population as well but the effects were apparently confounded, with lowered variance in the P-set due to irradiation. With respect to seed yield, there was a progressive increase of variance with recurrent intercrossing and with irradiation. These results are based on only the first 2 generations of a planned 4-generation experiment, and therefore the results, though encouraging, are still inconclusive with respect to attainment of the principal objective. (BBB)

24387 AN EVALUATION OF EFFECTS OF MASS SELECTION AND SEED IRRADIATION WITH THERMAL NEUTRONS ON YIELD OF CORN. Gardner, C. O. (Univ. of Nebraska, Lincoln). Crop Sci., 1: 241-5(1961).

Mass selection based on grain yield of individual plants practiced in a sample of an open-pollinated variety of corn since 1955 and on a sample of the same variety of which the seed was subjected to thermal neutron radiation in 1955 and again in 1957. This sample was exposed to 1.28×10^{13} thermal neutrons/cm^2 in the nuclear reactor at Brookhaven National Lab prior to planting in isolation. Radiation damage was severe: emergence was delayed, plants were substantially reduced in height, many plants showed yellow or white stripes on the leaves, and the incidence of smut was 3 times greater than in the controls. In 1957, thermal-neutron irradiation of the seed was repeated using a lower dose, 9.64×10^{12} thermal neutrons/cm^2 on one lot of seed and 9.98×10^{12} on the other. Mass selection resulted in a 3.9% gain/yr over the original variety. Although the irradiation treatment was detrimental to yield, the irradiated strain significantly outyielded the original variety and yielded only slightly less than the mass-selected control strain after 4 generations of selection. Irradiation of an already genetically variable population is probably not particularly valuable as a breeding procedure; yet it is too early to draw definite conclusions. Additional generations of selection are needed. Because of its simplicity and apparent effectiveness, mass selection of individual plants is suggested as a possible method of yield improvement in populations of corn segregating for genes controlling yield. Where the advantages of hybrids other than yield are desired, mass selection is suggested as a possible means of increasing the frequency of favorable genes in segregating populations prior to inbreeding. If overdominance exists at any locus, mass selection will not be successful in altering gene frequency for that locus after an equilibrium point has been reached: however, overdominance may not be of major importance in yield of corn. (BBB)

24388 POLYPLOIDY AND RADIOSENSITIVITY. Natarajan, A. T. (Indian Agricultural Research Inst., New Delhi). J. Indian Bot. Soc., 43: 283-93(1964).

This review indicates that radiation-induced lethality decreases with increase in the polyploid state. A survey is given of the extent of radiosensitivity in polyploids of higher plants as measured on the following criteria by different investigators. (a) Dose required to give a 50% or complete killing of growing population; (b) The extent of chromosome breakage for a given dose of radiation in root meristematic cells; (c) Reduction in the DNA content following irradiation; (d) The extent of inhibition of seedling growth; (e) The extent of multivalent formation in plants derived from irradiation seeds at M_1 generation; (f) Reduction in seed fertility; and (g) The incidence of chlorophyll mutations and viable mutations in M_2 and subsequent generations. The material surveyed included polyploid series of Chrysanthemum; polyploid series of Sedum; diploid (Triticum monococcum), tetraploid (T. dicoccum) and hexaploid (T. aestivum) wheats; diploid and autotetraploid barley (Hordeum vulgare); diploid and tetraploid Sorghum; and diploid and tetraploid cotton. The data indicated that radioresistance is proportional to the degree of ploidy, particularly in artificially induced autopolyploids. In naturally occurring allopolyploids the same trend holds but not in direct proportion to chromosome or genome numbers. The sensitivity may be modified and conditioned by the presence of a highly radiosensitive genome such as that of the A. squarrosa genome in hexaploid wheat. In general, polyploids yield more viable mutations than diploids, with later generations than M_2 yielding more mutations depending on the genetic make-up of the character involved. The frequencies and spectrum of mutations and the generation in which the mutations are isolated could provide additional evidence concerning the extent of genic and segmental duplication present in polyploid plants. This technique offers a useful supplement to other methods of determining the nature of polyploidy in plants. (BBB)

24389 STUDIES ON ERADICATION OF ANOPHELES PHAROENSIS BY THE STERILE-MALE TECHNIQUE USING ^{60}Co. II. INDUCED DOMINANT LETHALS IN THE IMMATURE STAGES. Tantawy, A. O.; Abdel-Malek, A. A.; Wakid, A. W. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo). J. Econ. Entomol., 59: 1392-4(Dec. 1966).

The percentage of induced dominant lethal mutations resulting from exposure of parental pupae to different doses of ^{60}Co γ radiation was determined in the metamorphic stages of Anopheles pharoensis. Dominant lethals were also estimated in the F_1 generation (in the egg stage only) after the eggs were irradiated. Doses from 500 to 5000 R with 500-R increments were used for pupae, and from 500 to 2000 R with 500-R increments for eggs (340 R/min). The percentage of induced dominant lethals in eggs of A. pharoensis irradiated by γ rays increased linearly with increasing dose; 100% lethality in the F_1 generation appeared at 2000 R. On the other hand, results from irradiated parental pupae demonstrated that dominant lethals in the egg, larval, and pupal stages of F_1 offspring were most effective during the egg stage followed by the larval stage; complete lethality was achieved at 4500 R and 5000 R, respectively. Irradiation of the F_1 pupal stage showed no significant effects; adults emerged from most of the pupae in spite of high doses of radiation. (BBB)

24390 ACTION OF LOW TEMPERATURES ON POSTRADIATION EFFECTS DURING STORAGE OF IRRADIATED SEEDS. Filev, K. (Central Lab. of Genetics, Sofia). Compt. Rend. Acad. Bulg. Sci., 19: 217-20(1966).

Although several investigations have shown that the extent of x ray and ^{60}Co γ-ray radiation injury can be considerably reduced if after the irradiation the biological objects are stored at low temperatures, most of the findings are quite contradictory. Consequently, barley seeds with a moisture content of 11.5% were irradiated with ^{60}Co gamma rays in doses of 1, 5, 10, and 18 kR at

two intensities of 16 and 253 R/min. Immediately after irradiation the seeds were allowed to germinate at 20°C and after 1, 15, and 30 days they were stored at 0 and –78°C. The results of cytological studies indicated that the low temperature caused, during the postirradiation period, a reduction in the number of chromosome aberrations at approximately the same degree in seeds irradiated with the same dose at different intensities; an exponential dependency was established when the percentage of chromosome aberrations as a function of the duration of storage was reduced; mathematical analyses based on the least square method showed a linear reduction in the percentage of aberrations at an increased dose for all postirradiation storage durations at 0° and –78°; the quantitative reduction of chromosomal aberrations was mainly at the expense of the fragments that showed that low temperatures affected the manifestation of potential breaks; with a high dose rate the effect of low temperatures during the postirradiation period was well defined but was not significant at a low dose rate; and low temperatures stopped the indirect action of radiation and prevented potential injuries from becoming irreversible. (JPRS)

24391 LINKAGE STUDIES IN PISUM. II. LINKAGE OF THE MUTANT AUREA$_{R3}$. Blixt, Stig (Plant Breeding Inst., Weisbullsholm, Sweden). Agri Hort. Genet., 24: 147-56(1966).

The pea mutant aurea (R3), represented as line No. 5106, originated from x-ray treatment of the variety Witham Wonder with a dose of 5,000 rads. The mutant is caused by a lethal gene, and has therefore to be maintained through the heterozygotes. The linkage of the gene responsible for the mutant aurea (R3) was studied in the cross B 251, line 5106 X line 1072. Line 5106 was found to have a translocation I/II, the breakage-point being closely linked with the mutant gene. As line 1072 in crosses had given no indication of deviating chromosome structure, the translocation is probably brought into the cross with line 5106, and considering the close linkage between the mutant and sterility, the mutant gene might as well be a minor chromosome deficiency arising at the translocation event. The location of the aurea mutant is not clear, since the only linkage found is with Oh in chromosome II. Considering, however, the strong linkage with semisterility and the translocation, it was assumed that this might be the same gene as Lamprecht's Au. Until the necessary identification crosses have been carried out, no gene symbol will be used. (BBB)

24392 MUTATIVE ALTERATION OF CHARACTERISTICS OF VEGETATIVE ORGANIZATION. Gottschalk, Werner (Univ., Bonn). Planta, 57: 313-30(Oct. 9, 1961). (In German).

Five mutants of Pisum sativum induced by x irradiation are described which exhibit characteristics in blossom structure that are either characteristic for other families or types of legumes or have not been present to any extent in genera of families studied before. A total of 40 mutants was observed, but the 5 described were taxonomically most characteristic. They involved the number of membranes in each zone, manifestations of irregular growth within the corolla and the androeceum, persistence of the corolla, and general alteration of the fruiting properties. A sixth, lethal mutant with an anomalous structure of its germination system was of phylogenetic interest. Out of 7 types of mutants only 4 were within a range of expected values for a 3:1 division, while the rest of the genotypes indicated a very high deficit in homozygotic recessive organisms. This deficit could be explained by an early elimination of mutated organisms immediately after germination. The mutants were regarded as new examples to validate the hypothesis that phylogenetically important changes could be produced by a single mutational shift. (BBB)

24393 MUTATIONS THROUGH X-RADIATION ALSO POSSIBLE WITH GREEN PLANTS. Knuth, M. (Humboldt-Univ., Berlin). Deut. Garbenbau, 9: 162-4(June 1962).

Nine variants of the ivy plant Hedera helix were treated with 1000 to 9000 R doses of x radiation in steps of 1000 R. Each variant was contained in 10 pots, and each pot contained 5 plants. The plants were 15 cm high. Most changes were observed in plants irradiated with 4000 R. One plant died after 6000 R, and the mortality increased as the radiation dose increased, so that at 9000 R 100% mortality was achieved. A second study was performed in which plants in 25 pots were irradiated with 4000 R in a single dose; plants in 25 pots were irradiated with a single dose of 3000 R plus 3 additional irradiations of 400 R each at intervals of 4 to 6 weeks; plants on 25 pots were given a single irradiation of 1500 R plus 4 additional irradiations of 1500 R each given 4 to 6 weeks apart; and plants in 25 pots were given a single dose of 700 R, followed by 5 additional treatments of 700 R, given 2 to 3 weeks apart. The defects that followed these treatments included chlorophyll deficiency, leaf deformations, and distortions of internodes. Although a complete evaluation of these changes has not been completed, one significant defect was observed in the growth of a cutting from these plants. The cutting appeared normal; however, during subsequent growth it developed chlorophyll deficiency and only small-sized leaves appeared on one side of the shoot. Later the defects appeared on both sides of the shoot. (BBB)

24394 IONIZING RADIATIONS IN CREATING NEW RICE VARIETIES. PRELIMINARY CONTRIBUTION. Borasio, Luigi; Corbetta, Giovanni (Stazione della Sperimentazione di Risicoltura e delle Coltura Irrigue, Vercelli, Italy). Ann. Vercelli Sta. Sper. Risicolt. Colt. Irrig., 5: 267-72(1962). (In Italian).

Some mutation selection experiments are described in which various varieties of rice seeds were subjected to different doses of ^{60}Co γ radiation and 31-MeV betatron radiation. With seed irradiated with 10,000 and 15,000 R of γ radiation, 35 to 40% developed into plants. After 20,000 and 25,000-R doses of betatron radiation, 10 to 20% of the seeds produced plants; after 30,000 and 35,000 R, only 8 to 12% of the plants reached maturity. Only 2 to 3 plants per 1000 irradiated seeds were obtained after doses of 70,000 and 100,000 R. The first generation (F_1) plants obtained showed a retardation of growth of about 15 to 20 days, accompanied by decreased seed production. This was more pronounced in the ^{60}Co γ-radiation than in the betatron series. The F_2 generation showed a number of chlorophyll-free plants and plants which died about a week after germination. In the ^{60}Co series, F_2 plants showed increased height, longer developmental cycle, and smaller seeds than in controls. The greatest number of mutants was obtained with doses of 30,000 and 35,000 R. At present, 27 mutant progeny of 3 rice varieties are being followed for mutants of economic value. (BBB)

24395 A SHIFT OF SEX-RATIO IN THE PROGENY FROM IRRADIATED MALES IN DROSOPHILA MELANOGASTER. Moriwaki, Daigoro; Tobari, Izuo; Ohba, Shigeru; Kitagawa, Osamu; Tobari, Yoshiko N.; Ikeda, Hiroshi (Tokyo Metropolitan Univ.). Idengaku Zasshi, 42: 23-38(Feb. 1967).

Results are reported from a study on the sex-ratio changes in the progeny from males x-irradiated at different germ cell stages in Drosophila melanogaster. (auth)

24396 THE EFFECT OF PRETREATMENT WITH MALEIC HYDRAZIDE OF THE MUTATION RATE INDUCED BY GAMMA RADIATION IN DROSOPHILA MELANOGASTER. Nasrat, G. E. (Cairo Univ.). Idengaku Zasshi, 42: 39-42(Feb. 1967).

Treatment with gamma radiation in combination with maleic hydrazide exhibits an additive effect on the formation of sex-linked recessive lethal mutations, when applied to Drosophila melanogaster spermatozoa. (auth)

24397 MUTAGENIC SPECIFICITY AT THE AD-8 LOCUS IN NEUROSPORA CRASSA. Ishikawa, Tatsuo (Tokyo Univ.). Idengaku Zasshi, 42: 43-50(Feb. 1967).

The distribution of mutations on the fine structure map at the ad-8 locus in Neurospora crassa has been analyzed. Multiple occurrences of independent mutations at particular sites have been confirmed for mutants of spontaneous origin and ones induced by bromodeoxyuridine and/or fluorodeoxyuridine and by ultraviolet irradiation. Spontaneous and x-ray-induced mutations were characterized by the frequent occurrence of multisite mutations. Discussions have been made on the possible mechanisms of mutations in comparison with some conclusions obtained in bacteriophage T4. (auth)

24398 GENETICAL REVERSION PRODUCED BY THE DECAY OF INCORPORATED ^{3}H-URACIL IN BACTERIA. Bockrath, Richard Charles Jr. University Park, Pennsylvania State Univ., 1965. 186p.

Thesis.

Tritium labeled compounds ^{3}H-thymidine, ^{3}H-uracil and ^{3}H-histidine may be incorporated into bacteria. If labeled bacteria are stored in a non-metabolizing environment to allow the accumulation of decays, the production of genetic reversion can be observed as a function of tritium decays. The efficiency of reversion per decay depends on the tritium compound incorporated. The decay of incorporated ^{3}H-uracil is most efficient. In order to learn more of the nature of reversion by ^{3}H-uracil, an extended program of study was conducted. The populations of revertant bacteria produced by different tritium compounds were examined to learn of any heterogeneity present. Theoretical calculations were executed, using a 7074 computer, to show energy distributions that may be expected in a bacterial cell as a result of tritium decay. Certain characteristics of some revertants produced by tritium were examined in detail and related to similar characteristics found in revertants produced by x rays or ultraviolet light. In all instances the reversion studied was that from arginine dependence to arginine independence. The results indicated a heterogeneity in the reversion populations produced by tritium, x rays and ultraviolet light. The heterogeneity was attributed to two different mutagenic alterations, each resulting in arginine reversion, but by different mechanisms. The radiation component of tritium decay was considered to produce these two

alterations at two different sites within the bacterium. A local chemical rearrangement at one of these sites seemed to result from the decay of incorporated ^{3}H-5-uracil and to account for its superlative mutative efficiency. (Dissertation Abstr.)

Health Physics and Safety

Refer also to abstracts 24116, 24291, 24298, 24340, 24354, 24357, and 24548.

24399 (AD-641880) IONIZING RADIATION, INJURY, PREVENTION, AND TREATMENT. Annual Progress Report. Rothe, William E.; Leitnaker, Frank C.; Butterfield, James L. (Army Medical Research Unit, Europe). July 1966. 37p. CFSTI $3.00 cy, $0.65 mn.

Simple but accurate and sensitive techniques have been established for total alpha counting of tissue and urine specimens and for ^{131}I quantitation in whole milk. Results are reported. Studies of Lean Body Mass (LBM) changes with physical conditioning have continued. Studies of blood preservation have been refined. (TAB)

24400 (AD-642313) EVALUATION OF RADIOPROTECTIVE ACTIVITY OR PROPERTIES OF SELECTED CHEMICAL COMPOUNDS IN LARGE ANIMALS. Annual Progress Report, July 1, 1965-July 1, 1966. Cole, L. J.; Alpen, E. L. (Naval Radiological Defense Lab., San Francisco, Calif.). 12p. CFSTI $3.00 cy, $0.65 mn.

The objective of the research was to investigate and evaluate the radioprotective activity and properties of selected chemical compounds in large animals, and to gain insights into their mechanism of action. With respect to chemical radioprotection efforts were directed toward three general areas: (a) Studies on Compound WR-1607 in lethally x-irradiated dogs (beagles as well as mongrels) and the possibilities of combinations of other compounds with WR-1607; (b) The protective effect of small external lead cuffs, alone or in combination with chemicals, in dogs; and (c) Studies on chemical radio-protection in mice, employing hemopoietic colony-forming units (CFU) as the endpoint. (auth)

24401 (BNL-10076) DESIGN AND CONTROL PROBLEMS ASSOCIATED WITH THE RADIOLOGICAL PROTECTION OF WORKERS OPERATING A LARGE DECONTAMINATION FACILITY. Pearsall, S. G.; Gemmell, L. (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 18p. (CONF-660403-2). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Symposium on Radiological Protection of the Worker by the Design and Control of his Environment, Bourenemouth, Eng.

Radiation protection problems in a large decontamination facility designed to use abrasive cleaning methods for the removal of radioactivity from heavy, bulky, grossly-contaminated equipment are discussed. The design and performance of air cleaning equipment; ventilation equipment; protective clothing, including protection against noise; waste disposal systems; radiation monitoring equipment; and other safety design features affecting the environment of the operators and the surrounding area are discussed. (C.H.)

24402 (BNWL-391) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, JANUARY-JUNE 1966. Essig, T. H.; Soldat, J. K. (eds.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT(45-1)-1830. 27p. Dep. CFSTI.

Surveillance of the Hanford environs during the first half of 1966 showed that the concentrations of radioactive materials in the vicinity were well within the appropriate limits and that radioactive wastes were under sound and continuous control. Except for the unusual release of radioiodines in February, ^{131}I concentrations in the Hanford environs were at very low levels during the first half of 1966. The Chinese weapons test of May 9, 1966, caused brief increases in ^{131}I concentrations in the environment, but concentrations soon returned to the low levels experienced during most of 1965. (C.H.)

24403 (GAT-R-397) HEALTH AND SAFETY ACTIVITIES REPORT FOR 1966. (Goodyear Atomic Corp., Piketon, Ohio). Apr. 5, 1967. Contract AT(33-2)-1. 80p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The Safety Department inspects operations, equipment, facilities, and work habits to disclose undesirable conditions and practices. The Safety Department also audits the safety programs of all other groups and prepares special and periodic reports for all levels of management. The following aspects of the Safety Department are reviewed: accident statistics; injuries; property damage summary; staff activities to reduce hazards; safety promotion and education; health and safety provisions of the labor contract; motor vehicle program; and equipment and company-furnished clothing. The Code Inspection Section of the Safety Department has the responsibility to formulate and administer an inspection program in such a manner as to insure safe operation and minimize damage to equipment. The equipment includes cranes, derricks, hoists, elevators, boilers, pressure vessels, and pressure relief devices. The equipment is inspected at regular intervals consistent with the hazard involved, usage, over-all importance, and applicable code requirements. The Fire Protection and Prevention Program is divided into three major phases: fire prevention, fire control, and fire safety education. Objectivities and functions of the Medical Service are described. Activities include annual physical examinations, treatment of occupationally injured employees, and immunization. The following aspects of Industrial Hygiene and Health Physics are summarized: contamination indices; continuous air samples; spot air samples (alpha activity); personnel monitoring program; nuclear accident dosimetry program; releases; scrap and surplus materials surveys; special equipment surveys; community problems; consultation, special problems, and miscellaneous activities; industrial hygiene; urinary program; toxic solvents; hearing conservation. (H.L.W.)

24404 (HASL-181) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, DECEMBER 1, 1966-MARCH 1, 1967. Hardy, Edward P. Jr.; Rivera, Joseph (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Apr. 1, 1967. 215p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

This report presents current data from the HASL Fallout Program, Isotopes, Inc., the National Radiation Laboratory in New Zealand, The Department of Scientific and Industrial Research in New Zealand, Argonne National Laboratory, and the U. S. Department of Agriculture. Radionuclide levels in fallout, milk, other diet components, and tapwater, are given in tabular form. The initial section consists of interpretive reports and notes covering the following topics: stratospheric trends and inventory of SNAP-9A debris; fallout of SNAP-9A debris; Sr-90, Ce-144 and Pb-210 in the upper stratosphere; Sr-90 deposition in the Atlantic Ocean: effect of salt spray on Sr-90 deposition; and Sr-90 dose to bone of N.Y.C. residents. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

24405 (HSR-RR-67/5-TI) CONSUMER BEHAVIOR AND WORKER PARTICIPATION IN RECOVERY ACTIVITIES. Chenault, William W.; Nordlie, Peter G. (Human Sciences Research, Inc., McLean, Va.). Feb. 1967. Contract OCD-PS-65-29. 79p.

This study is concerned with the problem of securing the participation of the survivors of a nuclear attack in an organized recovery effort. It describes the potential effects on motivation and organization of the different localized perspectives in which individual survivors would view disaster and respond to demands for nationally oriented work activity. The study assumes that recovery would require the integration of recovery activities on a national basis, that forcing functions of time would be placed on the performance of critical recovery activities, that survivors would perceive a scarcity of consumer items (especially food), and that the natural proclivities and motivations of survivors would lead them to engage in activities other than those required by an integrated national effort. Given those assumptions, the report describes a set of system characteristics that would, if built into a distribution system for consumer goods, allow the system to perform two tasks: (1) meet consumer needs and (2) provide the means for guiding the postattack behavior of survivors toward the performance of critical recovery activities. (auth)

24406 (IA-1090) RELATIVE HAZARDS OF FISSION PRODUCTS IN THE ENVIRONMENTAL HAZARDS EVALUATION OF NUCLEAR REACTORS. Tadmor, J.; Galron, H. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Sept. 1966. 35p. Dep. mn.

The absolute and relative hazards of the different fission products are presented from the point of view of the hazards evaluation of nuclear reactors, taking into consideration external irradiation from a cloud and contamination of land, and internal irradiation from radioisotopes that enter the human body via the respiratory system. (auth)

24407 (LFEN-50) ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS ON L.F.E.N. (1960-1965). Galvao, Julio Pistacchini; Ribeiro da Fonseca, Augusto Jorge; Godinho, Maria Manuela; Teixeira, Manuel Ribau; de Barros, Margarida Gaspar (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1966. 95p. Dep. mn.

The methods used for environmental radioactivity measurements at "Laboratório de Ffsica e Engenharia Nucleares" are described and discussed and the results obtained from 1960 to 1965 are presented. (auth)

24408 (N-66-24123) ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR IONIZING RADIATION IN SPACE. Prog-

ress Report No. 13, December 1, 1965–February 28, 1966. Schaefer, Hermann J. (Naval School of Aviation Medicine, Pensacola, Fla.). [1966]. 3p. (NASA-CR-71812). CFSTI $3.00 cy, $0.65 mn.

When exposed to radiation from solar particle beams under conditions of light shielding, it was considered that the radiation dose in the skin will be the limiting factor as far as permissible exposure is concerned. Studies were undertaken to analyze the pertinent dose distributions both on the rad and rem dose level. The relative biological effectiveness factors of the alpha and medium heavy component of flare beams was also of major interest. Three representative spectra were selected with rigidity gradients corresponding to P_0 values of 50, 125, and 300 Mv in the exponential formula $J = J_0 \exp(-P/P_0)$ for the integral spectrum. The data derived from these studies showed that the contributions of the alpha and medium heavy component to total dose grow substantially as P_0 grows. The rad doses in the skin for a normalized proton dose rate of 100 rads/hr are listed and the magnification of dose fractions, from the heavy components, if rad doses are converted to rem doses is discussed. (STAR)

24409 (NASA-TM-X-1361) LONG-LIVED RADIOACTIVITY PRODUCED IN NORTHERN OHIO CONCRETE MATERIALS BY NEUTRON ACTIVATION. Myers, Ira T.; Kish, James A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 11p.

Measurements were made of trace element concentrations of concrete materials (cement, sand, and gravel) to be used in the NASA Plum Brook Space Propulsion Facility near Sandusky, Ohio. The purpose of the measurements was to select material that would minimize neutron activation of the completed facility during a nuclear test. Exposure rates resulting from best- and worst-case material selection are considered as a function of decay time after a nuclear test has been completed. The major activities found after neutron irradiation were due to ^{60}Co, ^{46}Sc, ^{59}Fe, ^{140}La, and ^{24}Na. ^{60}Co was significant only for irradiation times of an order equal to or greater than its half life. For most projected nuclear tests, ^{46}Sc and ^{59}Fe had the most significant activities. The ratio of cobalt to iron had a value of 0.00045 ± 0.00025 by weight for the materials tested. (auth)

24410 (NIRS-5, pp 1-10) PHYSICAL SCIENCES. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported on the following subjects: computer program for determination of ^{137}Cs and ^{40}K in humans with use of whole body counter; estimation of air dose from atomic bombs at Hiroshima and Nagasaki; estimation of leukemia significant dose due to x-ray diagnosis; effects of last dynode capacity in space charge saturation type pulse shape discriminator; alpha-ray dose near Thorotrast aggregate; radiation dose in criticality accident; and energy calibration of organic scintillation detector by use of external gamma source. (W.E.B.)

24411 (NIRS-5, pp 63-6) ENVIRONMENTAL STUDIES. (National Inst. of Radiological Sciences, Chiba (Japan)).

A scintillation detector was used to measure natural gamma radiations inside residential structures. The three major sources of gamma rays were ^{40}K, ^{238}U, and ^{232}Th. The strontium content of bone, organic materials, foods, fresh water, sea water and soils was determined by atomic absorption spectrophotometry. (H.L.W.)

24412 (NP-16590) COMPORTEMENT DU CESIUM 137 DANS LES RESERVOIRS D'EAU DOUCE, COMPTE TENU DES REACTIONS DE PHYTOCENOSES A LA CONTAMINATION. (Behavior of ^{137}Cs in a Reservior of Fresh Water, Taking Account of the Reactions of the Phytocoenoses to Contamination). Note Bio-V/9. Wlodek, St. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). July 1965. 72p. (In French). Dep. mn.

A laboratory study was made of the effect of the plants in an aqueous ecological system on the contamination of the environment by ^{137}Cs. With respect to radioprotection, conclusions were made on the distribution of the ^{137}Cs in a fresh water reservior, the effect of the associations of hydrophytes on the distribution of ^{137}Cs in the water, the possibility of the biological decontamination of the water by plant harvesting, the prospects for a secondary contamination, and the value of aquatic plants as bioindicators. (tr-auth)

24413 (ORNL-P-2954) FRESHWATER FISH IN A NUCLEAR DISASTER. Shinn, Alvin F. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 12p. (CONF-670208-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 1st Commercial Fish Farming Conference, College Station, Tex.

The vulnerability of food stocks, crops, food production, and food processing capacities to nuclear attack is discussed. Data on the status of current U.S. food stocks are reviewed. It is pointed out that livestock provide about 66% of the protein in the U.S. diet. Data are presented from studies that showed that 60% or more of the livestock would survive various nuclear attacks. Because of the importance of good quality protein in the diet, especially that of children, a search was made for an alternate source of protein. It was concluded that freshwater fish farms offer relatively invulnerable sources of high quality protein that would contribute significantly to the maintenance of adequate protein intake by the population in the event of nuclear attack. (C.H.)

24414 (ORNL-TM-1766) DESCRIPTION OF FACILITY RADIATION AND CONTAMINATION ALARM SYSTEMS INSTALLED IN THE TRANSURANIUM PROCESSING PLANT, BUILDING 7920. Holladay, J. H.; Knowles, D. J. (Oak Ridge National Lab., Tenn.). Apr. 3, 1967. Contract W-7405-eng-26. 21p. Dep. CFSTI.

Facility radiation and contamination alarm systems were installed in the Transuranium Processing Plant, Building 7920, to continuously and automatically monitor the air contamination level and gamma radiation level in the entire facility. The monitoring instruments in the network are used to provide health physics monitoring information, local alarms when abnormal conditions occur, and remote alarms on a central monitoring panel located in the operating area. Fourteen alpha constant air monitors and six beta-gamma constant air monitors continuously sample the air in the building for radioactive particulate matter. Ten of the fourteen alpha constant air monitors and four of the six beta-gamma constant air monitors are used in the facility contamination system. Two monitrons, not part of the system, continuously monitor for gamma radioactivity. All monitors annunciate at the central monitoring panel. Operating personnel are first given warning when air-borne contamination detected by an air monitor reaches a preset caution level, and a second warning is given when a "high level" is detected. The monitrons give warning when the radiation level reaches 7.5 mr/hr. The building evacuation system operates automatically when two or more selected alpha air monitors or two or more selected beta-gamma air monitors detect a high level of air contamination. (auth)

24415 (PG-Report-774) THERMAL NEUTRON DEPTH DOSE DEPENDENCE ON BEAM AND PHANTOM SIZE FOR INCIDENT COLLIMATED BEAMS OF FAST NEUTRONS. Lawson, R. C.; Watt, D. E. (United Kingdom Atomic Energy Authority, Annan (Scotland). Production Group). 1967. 20p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 2s. 6d.

Thermal neutron flux distributions produced at depth in tissue-equivalent liquid were measured for several collimated beams of incident fast neutrons with the object of obtaining data for calculating the $^1H(n,\gamma)^2D$ and $^{14}N(n,p)^{14}C$ doses delivered under conditions experienced frequently in radiobiological experiments. It is demonstrated that two group theory can be used to predict accurately the distribution of thermal neutron flux with depth and also the position of the peak value. A simple formula is given which permits the magnitude of the peak to be determined for any beam size between 5 cm and 17 cm diameter relative to that measured for one beam size. By a combination of these formulae a complete description of the thermal neutron flux at depth in tissue can be obtained. Studies on the magnitude of the flux distribution caused by changes in the phantom dimensions lead to the conclusion that the naturally occurring statistical variations about the size of the standard man phantom do not produce an important change in dose level. (auth)

24416 (RA-5) ONDERZOEK VAN ^{90}Sr, ^{89}Sr EN ^{137}Cs IN RUWE ZOGENAAMDE BOERENMELK IN NEDERLAND. SAMENVATTING VAN RESULTATEN IN DE PERIODE 1959–1962. (Survey of ^{90}Sr, ^{89}Sr, and ^{137}Cs in Raw Milk in the Netherlands. Summary of Results in the Period 1959 to 1962). (Rijks Instituut voor de Volksgezondheid, Utrecht (Netherlands)). July 1965. 12p. (In Dutch). Dep. mn.

Results of the measurements of the ^{90}Sr, ^{89}Sr, and ^{137}Cs content of raw, liquid milk in the period between 1959 and 1962 are tabulated. Sampling in the former period was carried out at dairies in the environment of Utrecht. In the latter period milk was sampled at 10 dairies distributed all over the country. (auth)

24417 (RA-8) EEN EENVOUDIGE METHODE VOOR HET BEPALEN VAN DE RADIOACTIEVE BESMETTING VAN MELK NA EEN REACTOR ONGEVAL. (A Simple Method for Determining the Radioactive Contamination of Milk After a Reactor Accident). Moonen, H. P. M.; Strackee, L. (Rijks Instituut voor de Volksgezondheid, Utrecht (Netherlands)). Dec. 1961. 14p. (In Dutch). Dep. mn.

A simple method is described to determine in a dairy the radioactive contamination of milk by iodine-131, as may occur after a reactor accident. The measurement is performed by dipping a beta-gamma probe of a radiation monitor, type Frieseke and Hoepfner FH 40 T, in a standard transport 30 liter milk container.

The contamination of the milk is calculated with the aid of an experimentally determined conversion factor. The method is sensitive enough to indicate a specific activity of 0.05 microcurie iodine-131 per liter. (auth)

24418 (RA-17) HET JODIUM-131 GEHALTE VAN GRAS, VEEVOEDER EN REGENWATER UIT DE OMGEVING VAN BILTHOVEN (DECEMBER 1961 TOT EN MET MAART 1962). DE METINGEN ZIJN VERRICHT IN HET KADER VAN HET ZOGENAAMDE "PROJECT GROENEKAN". (The ^{131}I Content of Grass, Cattle Feed, and Rain Water From the Surroundings of Bilthoven (December 1961 to March 1962). The Measurements Were Carried Out in the Scope of the So-Called "Project Groenekan"). Mattern, F. C. M. (Rijks Instituut voor de Volksgezondheid, Utrecht (Netherlands)). July 1962. 15p. (In Dutch). Dep. mn.

Results of measurements of iodine-131 in grass, cattle-fodder and rainwater are given and compared with values calculated from the gross beta-activity of rainwater. It appears that only 2 to 3% of the deposited iodine-131 is retained in the grass. (auth)

24419 (UCRL-50175) SUMMARY REPORT OF CRITICAL EXPERIMENTS PLUTONIUM ARRAY STUDIES, PHASE I. Morton III, J. R.; Pierce, G. A.; Gardner, L. L.; Ball, C. J. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 22, 1966. Contract W-7405-eng-48. 56p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A series of small-scale 3-dimensional arrays of 3-kg cylindrical α-plutonium billets was studied. The parameter measured was the surface-to-surface spacing of the billets at the critical condition. The following systems were studied: 2^3 ($2 \times 2 \times 2$) arrays bare, reflected and moderated; 2×2 arrays of 6-kg pairs bare and moderated; 3^3 arrays bare and reflected; and 3^3 arrays containing several perturbations. Multiplication measurements are also reported for an extensive group of irregular arrays, which were relevant to the operational safety of the program. (auth)

24420 (UNC-RD-3061) SOME PROBLEMS AND ADVANCES IN THE STATE-OF-THE-ART IN THE ANALYSIS OF THE WOOD RIVER JUNCTION, RHODE ISLAND ACCIDENTAL CRITICALITY EXCURSION. Shapiro, M. M.; Nakache, F.; Soodak, H. (United Nuclear Corp., White Plains, N. Y. Development Div.). Apr. 1965. Contract AT(30-1)-2303. 26p. (CONF-650616-32).

From Health Physics Society Annual Meeting, Los Angeles.

An accident at the Wood River Junction of the United Nuclear Corporation resulted in the death of one employee. Methods of recovering uranium from dilute solutions are described. The victim of the accident poured a bottle of concentrated uranyl nitrate solution into a stainless steel tank containing sodium carbonate solution; when he had finished, an excursion of 10^{17} fissions occurred. Following the initial criticality accident two men entered the area in order to drain the contents of the tank into safe-geometry containers. Problems related to dose determinations of these two men and the man who died are discussed in detail. Gamma ray exposures were deduced from neutron data from the man who died. Blood sodium activation and activation of sulfur in the hair were used in dose determinations. Fast neutron activations were consistent with a whole body dose of 5100 rad. Estimations of dose to the men who entered the area after the accident were based on blood sodium activation, which gave a dose of 2 to 5 rad, and hair activation, which gave a dose of 60 to 80 rad. Thermal neutron activation data were used to supplement fast neutron data. It is pointed out that dose estimates from thermal neutron activation measurements were in good agreement with those estimated by blood sodium activation. (H.L.W.)

24421 (ANL-Trans-458) INTAKE AND EXCRETION OF NATURAL RADIONUCLIDES ^{210}Pb AND ^{210}Po BY HUMANS. Gloebel, Beowulf; Muth, Hermann; Oberhausen, Erich. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Strahlentherapie, 131: 218-26(1966). 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Present investigations were done in order to obtain a survey of ^{210}Pb and ^{210}Po intake with food and drinking water and of the excretion of both these radionuclides in humans. With the instrumentation used, specific activities of ^{210}Pb and ^{210}Po as low as 2×10^{-16} Ci/g of substance can be determined. The results show that a normal person takes in, on the average, 4 to 5 pCi of ^{210}Pb and ^{210}Po per day in the diet. The excretion has the same order of magnitude; great daily variations were observed for intake and excretion. It could be shown that grassy plants take up both nuclides from the soil and by direct absorption from the precipitation of plants above the soil. (auth)

24422 (NRC-TT-1264) RADIATION HAZARDS IN WORK WITH ISOTOPES. Lindell, Bo. Translated by H. Nathan (National Research Council of Canada, Ottawa), from Lakartidningen, 62: (42): 3447-57(1965). 19p. JCL $1.60 fs, $0.80 mf.

Acute, genetic, and cancerogenic efforts of radiation are reviewed. Hazards of occupational exposure to radioisotopes are discussed with emphasis on the maximum permissible dose concept, and measures for radiation protection of personnel in Sweden are considered. (H.G.D.)

24423 PROTECTIVE EFFECT OF CYSTAMINE AND AET GIVEN AT VARIOUS INTERVALS BEFORE IRRADIATION. Tkadlecek, L. (Military Inst. of Medical Research, Hradec Kralove, Czech.); Juraskova, V. Nature, 213: 1267-8(Mar. 25, 1967).

Employing the spleen colony technique described by Till and McCulloch the authors investigated the dose reduction factor for cystamine on haematopoietic stem cells in mice. It was found that the dose reduction factor varied with the time elapsing between intraperitoneal injection of the cystamine and the irradiation, particularly during the first 15 min. Irradiation was performed at 436 R/min (x irradiation) and it was demonstrated that the maximum radioprotective effect occurred from the fourth to the sixth minute after injection. Similar results were obtained with 2-β-aminoethyl isothiouronium (AET), but the dose reduction factors for cystamine were higher than for AET at first, falling to those for AET after about 8 min. These results may be due to metabolic differences and the pharmacological properties of cystamine. (INIS-UK)

24424 DEPOSITION AND CLEARANCE OF RADIOACTIVE PARTICLES IN THE HUMAN LUNG. Albert, Roy E.; Lippmann, Morton; Spiegelman, Jack; Liuzzi, Anthony; Nelson, Norton (New York Univ.). Arch. Environ. Health, 14: 10-15(Jan. 1967).

A summary is presented of the current status of information on the clearance of radioactive particles from the human lung as measured by external γ detectors. Several studies are reviewed. Equipment developments such as a spinning-disk aerosol generator are discussed and well as some scintillation counters used in analyses. Actual lung clearance patterns are shown for two human subjects for chromium-51 and gold-198 for 3 to 5μ particles. (TSS)

24425 HYGIENIC FEATURES OF NATURAL ULTRAVIOLET RADIATION IN LENINGRAD. Generalov, A. A. (Leningrad Medical Inst. of Pediatrics). Gig. Sanit., No. 10, 3-7(Oct. 1966). (In Russian).

The author studied the ultraviolet radiation in Leningrad by means of a photoelectric method and by determining the onset of the threshold erythema on the human skin. The findings characterize the intensity and the quantity of ultraviolet radiation on different days, months and throughout the year, as well as its biological action. In the author's opinion, for the population of Leningrad, the time spent in the open provided the necessary preventive (1/8 erythema) dose of ultraviolet rays. The dose received in March in the middle of the day comprises 44 min, in the morning (10 a.m.) and in the evening (4 p.m.)–95 min; in September it amounts to 24 and 52 min respectively; in April, May, July, and August–13 and 20 min and in June–9 and 13 min, respectively. (TSS)

24426 ACCUMULATION OF LONG-LIVED DAUGHTER PRODUCTS OF RADON IN HUMAN BODY AFTER DRINKING OF RADON WATERS. Andreev, S. V. Gig. Sanit., No. 10, 36-42 (Oct. 1966). (In Russian).

The paper deals with assessment of the possibility of accumulation in the human body of long-lived daughter products of radon as a result of drinking radon waters. Analysis of the data obtained shows that such an accumulation of isotopes is quite insignificant and under ordinary conditions it cannot lead to appearance in human body of RaD (^{210}Pb), RaE (^{210}Bi) and ^{210}Po in concentrations approaching the maximal permissible values. (auth)

24427 PROBLEM OF CONTROL OF RADIOACTIVE CONTAMINATION OF WATER AND AIR WITH URANIUM TOGETHER WITH ITS DAUGHTER PRODUCTS. Shalaev, I. L. Gig. Sanit., No. 10, 42-6(Oct. 1966). (In Russian).

On the basis of the calculated maximum permissible concentration of uranium and the actinium series of isotopes, it is demonstrated that in certain cases the radiation hazard of water and air contamination with uranium and its daughter products is actually determined less by the uranium itself than by its daughter products, such as ionium, polonium, radium (in the air) and RaD, Po, Ra (in the water). The methods of determining the extent of contamination differ depending on the presence or absence of information on the changes in the balance of the uranium series. In the first case it is possible to detect any member of the series; in the second case it is necessary to know the concentration of all the isotopes, that determine the value of the maximum permissible concentration of the mixture. In both cases it is possible to control the extent of the contamination by determining the total activity. However, if the shifts in the balance are unknown, such a method may prove to be too rough. Equations are given for determining the maximum permissible concentration both with and without regard for the type of isotope distribution in the human body. (auth)

24428 SKIN DOSES FROM GLASS AND BERYLLIUM WINDOW X-RAY TUBES IN MAMMOGRAPHY. Hranitzky, E. B.; Shalek, R. J. (Univ. of Texas, Houston). Radiology, 88: 668-71 (Apr. 1967).

Measurements of radiation exposure from diagnostic x-ray machines were made under conditions closely approximating those routinely employed for Type M Film mammography. Skin doses, which are functions of x-ray tube design, beam filtration, target-to-skin distance, peak kilovoltage, and tube current, range from less than 2 to about 23 RADS per film exposure. An x-ray tube with a 1.0 mm beryllium window and 1.00 mm aluminum added filtration was found to produce skin doses of less than 13 RADS per film exposure. These are comparable to doses from glass window tubes having no added filtration. (auth)

24429 CHARACTERIZATION OF FIXED STRONTIUM IN SESQUIOXIDE GEL–KAOLINITE CLAY SYSTEMS. Frere, M. H.; Champion, D. F. (Dept. of Agriculture, Beltsville, Md.). Soil Sci. Soc. Amer., Proc., 31: 188-91(Mar.-Apr. 1967).

"Fixed" Sr is defined by the amount of radioactive Sr remaining with the solid phase after three extractions with 1N $Sr(NO_3)_2$. The amount of Sr fixed in a soil–water suspension increased with time in a manner characteristic of a slow diffusion process. Experiments with Fe or Al gel-kaolinite clay suspensions showed a similar behavior. The amount of fixation in gel-clay suspensions increased with pH to a level of about 6% of the adsorbed Sr at pH 8. The reaction was insensitive to the amount of gel and decreased with the aging of the gel–clay suspension. The level of fixation in the gel–clay suspensions was considerably less than observed in soils, particularly when acid pH's and aged systems were considered. Several exploratory experiments indicate a silicate interface may be important in the fixation mechanism. (auth)

24430 CARRYING OUT MISSIONS FROM A CONTAMINATED AIRFIELD. Gajic, P. Vazduhoplovni Glas., No. 2, 117-30 (1966). (In Slovak).

The paper deals in some detail with radioactive and chemical contamination of an airfield and radiation effects on humans and other objects. Operations on a contaminated airfield performed with various degrees of radiation and involving aircraft; safety measures; determination and control of the contaminated area; decontamination of the airstrips, access roads, and areas for various types of work; preparation of aircraft; protection of the crew; and takeoff and landing on a contaminated airfield are discussed. Tables and diagrams show relationships between the degree of radioactive contamination and various types of work, maximum working time as a function of air temperature, decrease in radiation intensity after one-hr, two-hr, three-hr periods following a nuclear explosion, and as a function of the dimensions of the decontaminated area; as well as the relationship between the size of a chemically contaminated cockpit and the time required to achieve a safe concentration of contaminant. (JPRS)

24431 AUTOMATED PILOT PLANT FOR REMOVING RADIOSTRONTIUM FROM MILK. Sadler, A. M.; Walter, H. E.; Hanrahan, F. P.; Edmondson, L. F. (Dept. of Agriculture, Washington, D. C.). J. Dairy Sci., 50: 268-71(Feb. 1967).

The removal of ^{90}Sr from milk by ion exchange resins was programmed through lab, pilot, and commercial scale plants. The operation is described and results from an automated pilot plant, using ion exchange resins to remove ^{90}Sr from milk, are presented The process involves adjusting the milk to 10°C; lowering the pH of the milk to 5.3 by in-line injection of an acid solution; passing the acidified milk through a filter and a properly charged (regenerated) ion exchange resin column for removal of ^{90}Sr; then readjusting the pH of the milk by in-line injection of a base solution. A series of 8-hr test runs was made with this automated pilot plant, using milk at environmental levels of ^{90}Sr, to ascertain removal of ^{90}Sr and to evaluate the resin-treated milk for flavor. Removal of ^{90}Sr from the milk exceeded 90%. The treated milk compared favorably with the control when subjected to a panel for organoleptic evaluation. (BBB)

24432 THE INACCURACY OF DOSE VALUES. I. THE INEVITABLE ERROR OF X IRRADIATION. Renner, Kh.; Hoefer-Janker, H.; Gruener, H. (Univ., Basel). Roentgen Bl., 19: 459-64(Sept. 1966). (In German).

Methods and instrumentation for measurement of x-ray doses in radiotherapy are described, and examples are cited to show how errors in dosage arise and, to some extent, can be avoided. The type of errors and their possible magnitude are described and estimated or computed for experimental measurements and irradiation therapy. For dose values presented in R (absolute values), a differentiation must be made between the error of the results measured (possible maximum error due to the dosimeter: for 100 R, up to ±16.8 R) and the error of a single irradiation (range of fluctuation due to the radiotherapy apparatus: at 100 R, up to ±15.6 R). Even in measurements or irradiations for legal purposes these errors can neither be avoided nor reduced. The reporting of mean probable errors, which must be kept low, is only useful for relative measurement and irradiation values, and must be strictly differentiated from the error described above. Errors that occurred in the use of standard dosimeters and other measuring instruments and in irradiation apparatuses are described. (BBB)

24433 ABSORPTION OF RADIOSTRONTIUM FROM A RAW FISH INTO A COOKED DISH IN THE COURSE OF COOKING. Skryabin, A. M.; Shukhovtsev, B. I.; Meshalkina, N. G. Gig. Sanit., No. 11, 111-13(Nov. 1966). (In Russian).

During the course of cooking of carp 1.1 to 2% of ^{90}Sr is absorbed by the edible part of the fish, 60 to 90% of the ^{90}Sr activity being concentrated in the solid part. From 0.2 to 2% of the ^{90}Sr is contributed by the bones. The extraction of radiostrontium and stable calcium is nearly identical (0.4 to 0.45%). (R.V.J.)

24434 RADIATION-HYGIENIC ASSESSMENT OF GROUND BURIAL PLACES FOR RADIOACTIVE WASTES. Bashmakova, T. A.; Sukalskaya, S. Ya.; Nikiforova, O. A.; Permyakov, A. A. Gig. Sanit., No. 11, 78-81(Nov. 1966). (In Russian).

Contamination of the area surrounding the waste disposal burial places was measured in specimens of settled dusts and plants at various seasons of the year. After 2 years of operation without any special cleaning the sewage did not affect the coastal zone of the open water basin. A few cases of contamination were related to the ventilation expulsion. The contamination was of low level and did not extend beyond the sanitation-protection zone. Radiation doses absorbed by the personnel handling the wastes were below permissible values, and no obvious effects to their health were detected. (R.V.J.)

24435 RADIATION PROTECTION FOR ENTRANCE DOORS OF COBALT THERAPY ROOMS. Calamini, A. (C. H. F. Mueller, Hamburg). Medicamundi, 11: 143-7(1966).

The exposure rate generated by ^{60}Co was measured in some installations. The attenuation factors were ascertained by means of measurements made at the rear of lead and steel clad doors, closed and open. The results provide data for the rating of entrance doors of cobalt-therapy rooms. (auth)

24436 DOSIMETRY OF X AND GAMMA RADIATION. Van Ammers, H.; Reinsma, K. (Philips X-Ray and Medical Apparatus Div., Eindhoven, Netherlands). Medicamundi, 11: 124-33(1966).

Physical magnitudes used in the medical application of ionizing radiations, and related instrumentation are discussed. Attention is devoted not only to conventional x-ray therapy but also to cobalt and cesium treatment, while for the sake of completeness mention is also made of the methods employed in conjunction with linear accelerators, betatrons etc. Problems encountered in the use of radioisotopes (radium and cobalt needles, gold pellets, and injections of radioisotopes), and the related magnitudes and measuring methods are discussed as well. A growing realization of the amount of radiation used in diagnostics is considered. (auth)

24437 ESTIMATION OF RADIATION DOSES TO TISSUES AFTER ADMINISTRATION OF TRITIATED CORTICOSTEROIDS TO THE RAT. Standeven, R. Margaret; Clarke, D. A. (Radiological Protection Service, Sutton, Eng.). Brit. J. Radiol., 40: 48-55(Jan. 1967).

Retention and distribution studies of tritiated corticosteroids in rats are described. The variation in radiation dose to a given organ following administration of cortisol –1, 2–T, D(+), aldosterone –1, 2–T, or corticosterone –1, 2–T is small and the corticosteroids may be considered as a group. Liver and kidney received the highest dose, about 1 rem/mCi and 0.4 rem/mCi respectively; the lowest dose was received by testes, fetus and brain, namely, 0.04 rem/mCi, 0.03 rem/mCi and 0.02 rem/mCi. Data obtained on rats were extrapolated to man, corrections being applied for differences between the species, such as weight, turnover rates and metabolic pathway. Considering the accuracy of dose estimations and assuming justification of extrapolation from rat to man, in occupational exposure, tritiated corticosteroids are about 30 times less toxic than tritiated water. For equal injected activities of tritiated corticosteroids to man and rat, doses to individual organs in man will be about 100 times lower than doses to corresponding organs of the rat. (auth)

24438 RADIATION DOSES RESULTING FROM THE ADMINISTRATION OF TRITIATED FOLIC ACID AND TRITIATED WATER TO THE RAT. Lambert, B. E.; Clifton, R. J. (Radiological Protection Service, Sutton, Eng.). Brit. J. Radiol., 40: 56-61(Jan. 1967).

The distribution and retention of radioactivity in various organs of the rat were investigated following injection of tritiated folic

acid and, for comparison, tritiated water. After an injection of 1 mCi folic acid, liver received the highest dose, about 90 rems, followed by kidney, 65 rems, and bone marrow, 15 rems. For tritiated water, the rat body received a fairly uniform dose of about 12 rems/mCi. On the basis of the recommendations of the International Commission on Radiological Protection, it is suggested that tritiated folic acid is about twice as toxic as tritiated water. (auth)

24439 A METHOD OF EVALUATING RADIATION RISKS FOR MANNED SPACE FLIGHTS. Billingham, John; Robbins, Donald E.; Ewing, David (Ames Research Center, Moffett Field, Calif. Manned Spacecraft Center, Houston, Tex.). Radiat. Res., 30: 541-56(Mar. 1967).

Problems concerning an evaluation of the hazard from doses of ionizing radiation during manned space flight are discussed. A method is given for statistically combining solar flare data with assessments of the likelihood for biological responses. This approach is aimed at synthesizing radiophysical and radiobiological data so that the interfaces between radiation, crew safety, and mission success can be better related to other hazards during mission planning. (auth)

24440 CHANGES IN THE MAXIMUM PERMISSIBLE DOSES OF IONIZATION RADIATION IN THE LIGHT OF THE LATEST RECOMMENDATIONS OF THE ICRP (INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION). Musialowicz, Tadeusz (National Committee for Radiation Protection, Warsaw). Pol. Przegl. Radiol. Med. Nuk., 29: 579-82(1965). (In Polish).

Recommended changes in the values for the maximum permissible dose of ionizing radiation for man and the establishment of maximum permissible dose of internal radiation from accumulated radionuclides as set forth by the ICRP are presented. Several recommendations are made by the ICRP. (TSS)

24441 RADIUM SURVEY IN ALABAMA. Willis, William T.; Cowan, Edward (Alabama Dept. of Public Health, Montgomery). J. Med. Ass. State Ala., 35: 860-6(Apr. 1966).

A leak test and contamination survey of known sources of radium within the State was made by the Alabama Dept. of Public Health. Details of the survey are discussed, as well as certain physical and chemical characteristics of radium to aid in understanding why radium sources leak and why contamination occurs. If the hermetic seal fails completely as a result of either internal pressure or external stress, a gross rupture occurs, resulting in the release and spread of the Ra powder. The survey described had 3 objectives: to test all known sources of Ra for leakage, to determine the presence of contamination, and to train staff personnel in conducting inspections of radioactive materials. The 30 facilities surveyed possessed a total of 2638 mg of Ra. The survey determined that 495 mg of this total was either leaking or contaminated. Thirteen of the 30 facilities possessed one or more leaking sources and all but one of the leaking sources were possessed by private physicians. Whenever a leaking Ra source was found, contamination of the immediate area was also found. Contamination was also present at five facilities that did not possess a leaking source, supporting the proposition that sources can leak intermittently. Generally, the contamination was confined closely to the area of the storage container and in no case was it widespread. This fact minimized the contamination hazard and made decontamination easy. Decontamination procedures involved a simple process of washing and scrubbing. (BBB)

24442 CURRENT STATUS OF RADIATION BURDEN IN HUMANS. Wagner, Gerhart (Univ., Zurich). Mitt. Naturforsch. Ges. Bern, 22: 183-94(1965). (In German).

The author first summarizes natural radiation burden, including radiation from incorporated radioisotopes, cosmic radiation from the sun and the Van Allen belts and terrestrial radiation. Radiation burden from artificial radioisotopes and the concept of maximum permissible dose are reviewed in terms of radiation burden from radioactive fallout and occupational exposure of personnel, and genetic dose. A practical example describing reduction of radiation burden in thoracic radiological and fluoroscopic studies is given. Basic principles and requirements of radiation protection are listed. (BBB)

24443 THE SIGNIFICANCE OF SUITABLE SCREENS IN DENTAL ROENTGENOGRAPHY. Truelle, M. A. (Krajska Hygienicko-Epidemiologicka Stanice, Ceske Budejovice, Czech.). Cesk. Stomatol., 66: 295-302(July 1966). (In Czech).

Effectiveness of radioprotective features of dental radiology equipment was assessed. After testing 118 dental x-ray machines it was found that only 15 were equipped with a satisfactory cone that restricted properly the irradiated field in intraoral pictures. With 103 machines the irradiated field was of an unsuitable size, ranging from 62 to 185 mm, depending on the type of the apparatus. The proper dia of the primary cone was determined. Other shortcomings were the absence of Al filters (additional) in 82.2% and defects resulting in overexposure. Owing to these irregularities both the patient and the examiner were exposed to undue doses of radiation, although a relatively simple adjustment was sufficient to improve substantially the radiation hygienic conditions for work in dental radiology. Radioprotective features, or lack of them, for 25 commercial types of x-ray apparatus are tabulated. (BBB)

24444 DANGER OF WORLD-WIDE RADIOACTIVE FALLOUT. Rescanieres, A. Lille Med., 10: Suppl., 1087-9(1965). (In French).

The hazards to human populations from fallout are assessed in terms of levels of irradiation from other sources. Certain populations, such as those living at high altitudes or in areas where terrestrial radioactivity levels are elevated, may be receiving environmental radiation exposures up to 10 times higher than the average of approximately 0.1 Rem/yr. Medical diagnostic and therapeutic radiation exposures may add another 0.1 Rem/yr to the population dose. The possible contribution of fallout radionuclides, especially ^{90}Sr, ^{137}Cs, and ^{14}C, is assessed. The dose provided by ^{90}Sr deposited in bone is estimated to be about $^1/_{10}$ of that produced by natural sources of radiation, and by ^{137}Cs internal contamination about $^1/_{100}$ the dose from the environment. The population dose from ^{14}C will be relatively lower, but because of its long half-life of 5700 yr it will be a source of irradiation to many subsequent generations. The total contribution from fallout radionuclides is estimated to represent 3 to 5% the dose from natural sources. This is equivalent to an increase in exposure to cosmic radiation that would result by living at a 300-m higher elevation. (BBB)

24445 ^{137}Cs LEVELS IN HUMAN BODY, DECEMBER 1962–JUNE 1965. Yamagata, Noboru; Iwashima, Kiyoshi (Inst. of Public Health, Tokyo). Koshu Eiseiin Kenkyu Hokoku, 15: No. 2, 49-52(June 1966).

The postmortem samples of human breast muscles collected in Tokyo continuously during the period from December 1962 to July 1964 were analyzed for cesium-137 and potassium. Variation in individual burdens was analyzed statistically and the frequency distribution was found not normal but positively skewed. The blood analysis was conducted on pooled blood samples from blood banks since February 1964 as a means of assessing body burden and the estimates of body burden are presented for the period Dec. 1962 and June 1965. Peak levels were observed during the period of spring of 1964 through the beginning of 1965, the maximum being 200 pCi per kg of body weight. (NSA of Japan)

24446 PROTECTION BY SUBSTRATE ANALOGUES FROM ULTRAVIOLET DAMAGE OF BOVINE PANCREATIC RIBONUCLEASE. Sawada, F.; Ichimura, S. (National Inst. of Radiological Sciences, Chiba, Japan). Nature, 213: 1266-7(Mar. 25, 1967).

It is known that bovine pancreatic ribonuclease (RNase) is protected by a substrate analogue from gamma irradiation damage and a modified active enzyme formed. The present authors found that several substrate analogues similarly protected RNase from damage by uv light. Experimental details are described. It was found that substances which cannot form a complex with the enzyme (including all nucleosides) are ineffective for protection. Nucleotides "transparent" to uv light also had no effect (ribonucleotides of dihydrouracil and uracil hydrate). A 3′-ribonucleotide was more effective than the other isomers, and all nucleotides of cytosine tested showed a remarkable protective effect. Protection by cytidine-2′(+3′)-phosphate was not influenced by oxygen in the medium. Mechanisms are not entirely clear. Complex formation of the enzyme with the substrate analogue and absorption of uv energy by the latter are assumed to be involved. (INIS-UK)

24447 MECHANISM OF ACTION OF AMINOTHIOL RADIOPROTECTORS. Brown, P. E. (Univ. of California, Berkeley). Nature, 213: 363-4(Jan. 28, 1967). (UCRL–16823).

The mechanism by which aminothiols protect living cells from radiation is discussed. One possibility is that they bind to and stabilize those parts of the DNA helix which are not covered by histones. This reduces both primary and secondary damage, and the DNA replication rate is decreased so that repair processes can act before alterations are replicated. (auth)

24448 LEVELS OF ^{137}Cs AND ^{90}Sr IN THE DIET AND THE URINE OF A YOUNG POPULATION AGED BETWEEN 8 AND 10 YEARS. Cigna, A.; Ferro-Luzzi, A.; Mariani, A.; Spadoni, M. A.; Tomassi, G. (Centro di Studio Nucleare, Casaccia, Italy). Boll. Soc. Ital. Biol. Sperim., 42: 1132-5(1966). (In Italian).

A study was instituted in February, 1964 to determine levels of radionuclide ingestion and excretion in children in Rome. The cesium units (CU, pCi Cs/g K) in the diet, determined monthly from February, 1964 to March, 1965, varied from a low of 41 CU in

August, 1964 to a high of 115 CU in September, 1964. The mean value for this period was 86 CU. The ^{137}Cs levels in the urine averaged 86 CU in male children aged 8 to 10 yr and 83 CU in females. The average ratio for dietary/urinary ^{137}Cs levels was 1.01 for both sexes. For ^{90}Sr the mean dietary level for 1964 was 29 SU (pCi Sr/g Ca), with a low of 18 SU in October, 1964 and a high of 44 in June, 1964. The urinary levels were 20 SU in boys and 25 SU in girls, giving a dietary/urinary ratio of 1.39 in boys and 1.41 in girls. The average dietary/fecal ratio was 0.73 for ^{90}Sr. (BBB)

24449 RADIATION RISKS AND RADIATION PROTECTION. Eriskat, H. Neue Tech., 8: 360-4(Dec. 1966). (In German).

The basic standards of EURATOM on permissible radiation doses are outlined, and the procedures used for the application and testing of these standards are given. The special risks entailed in the separation of radioactive materials and methods used for the monitoring of environmental radioactivity are discussed. Research activities in the field of radioprotection are briefly described. (J.S.R.)

24450 RADIOPHARMACEUTICALS: PHARMACEUTICAL AND RADIATION HYGIENE PROBLEMS. Kristensen, Knud (National Health Service, Copenhagen). Dansk Tidsskr. Farm., 40: 171-92(June 1966). (In Danish).

A survey is given of the increasing use of radiopharmaceuticals in Denmark, with emphasis on the pharmaceutical and radiation hygiene problems involved in production, control, storage, distribution, and use of these compounds. Hazards associated with the distribution of radiolabeled drugs are examined in particular. It is concluded that problems associated with regulating radioactive pharmaceuticals in Denmark could best be solved by establishing a Pharmaceutical Isotope Laboratory. This laboratory would supply Danish hospitals with radioactive drugs and have the responsibility that all radiopharmaceuticals in use be of a satisfactory quality, that is, by purchasing, controlling, and distributing radiopharmaceuticals. The laboratory would also advise physicians concerning the quality, properties, and storage conditions, and publish guides and instructions for control of radioactive drugs. It is considered important to maintain a laboratory where the experience and knowledge of relevant problems concerning radiopharmaceuticals are available and can be placed at the disposal of the clinician. (BBB)

24451 ACCEPTABLE CONCENTRATION OF RADON IN DRINKING WATER. Hems, G. (Radiological Protection Service, Sutton, Eng.). Int. J. Air Water Pollut., 10: 769-75 (Oct. 1966).

Recommendations are made for acceptable concentrations of Rn in domestic water supplies. Following ingestion of Rn in water, the stomach receives the highest dose. The International Commission on Radiological Protection recommended that for the general population the dose to the stomach should not exceed 0.5 rem/yr; however, there is no evidence to indicate whether or not consumption of Rn water, which could deliver a dose of 0.5 rem/yr to the stomach would have any deleterious effects. Radon is poorly soluble in water, and is readily lost by aeration. The intake of Rn, by mouth, would be determined by the amount of raw water drunk. In temperate climates, a reasonable average figure would be 300 ml/day; the remainder of the daily intake would be as beverages for which the water was boiled, and most of the Rn removed by aeration. A further factor in calculating the daily intake of Rn is the loss of Rn by aeration when collecting the water at the tap, and also during swallowing. When the Rn concentration is measured a sample would be collected with care to avoid losses by aeration and so the product of the measured Rn concentration and the daily intake would overestimate the amount of Rn ingested. The concentration of Rn in drinking water, measured at the tap, which would lead, in a large population to a dose of 0.5 rem/yr to the stomach, is 20,000 pCi/l. This value is based on a daily intake of 300 ml of water, and, in view of losses mentioned above, the Rn concentration is likely to be a conservatively low estimate. (BBB)

24452 VADE-MECUM DU TECHNICHIEN. CONTROLE DES RAYONNEMENTS IONISANTS ET MISE EN OEUVRE DES TECHNIQUES DE PROTECTION. TOME PREMIER. (Handbook for Technicians. Control of Ionizing Radiations and Development of Protection Techniques. Volume I). Pannetier, Raymond. Paris, Francis Duhanel, 1966. 746p.

A handbook is presented for technicians on control of ionizing radiations and protection techniques. The contents include review of radiation units, mathematics, atomic physics and electronics, nuclear physics and radioactivity, measurement of ionizing radiation, standards and calculations of dose and dose output, protection against irradiation and contamination, methods for decontamination, organization of radioprotection, a bibliography, descriptions of nuclear centers, and a nuclear dictionary. (J.S.R.)

24453 THE LOG-NORMAL FUNCTION AS A STOCHASTIC MODEL OF THE DISTRIBUTION OF ^{90}Sr AND OTHER FISSION PRODUCTS IN HUMANS. Schubert, Jack (Univ. of Pittsburgh); Brodsky, Allen; Tyler, Sylvanus. 37p. (CONF-660621-20). ORAU. Gmelin, AED-CONF-66-193-13.

From Health Physics Society, 11th Annual Meeting, Houston, Tex.

Data on the concentrations of Sr-90, Ra-226, Cs-137, and some of the stable trace elements in human tissue as well as environmental samples have been found to follow log-normal distributions rather than normal distributions. Also, while the median of the Sr-90 concentration in humans shifts for different time periods, areas of the world, and population age distributions, the geometric standard deviation has seemed recently to remain within the relatively narrow range of 1.55 to 1.67 for large population groups, so that about the same proportion of each population contains concentrations in excess of a given multiple of the median (or the average) concentration. The log-normal distribution fits the data better than the normal distribution particularly in the "tail" of higher concentrations. This is the region most critical for the evaluation of the proportions of the population exceeding recommended limits of individual exposure. The repeated suitability of the log-normal permits the recommended limits of environmental contamination to be established with more confidence in predicting the proportions of the population exceeding any given level. The log-normal line fitted to 1964-65 U. S. data indicates that less than 25 persons will have bone doses exceeding twice the average. Extrapolation of the log-normal distribution would indicate that less than 0.36 percent of the population under age 25 would exceed 10.4 $\mu\mu C$ Sr-90/gram calcium (3 times the average). The same percentages would apply to the corresponding multiples of the average Sr-90 concentration per gram of bone. The log-normal function was also found to be applicable for estimating external exposure distributions. The external radiation dose-rates at 210 locations in the United States in 1962 and 1963 fitted a log-normal frequency distribution having a median of 5.5 μR/hour and about the same geometric standard deviation ($s_g = 1.67$) as Sr-90 in human bones. (auth)

Medicine

Refer also to abstracts 24211, 24233, 24324, 24325, 24349, 24353, 24428, 24436, 24565, 24573, 24574, 24592, 24641–24644, 24687, 24689, and 25367.

24454 (NIRS-5, pp 57-62) MEDICAL STUDIES. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported on the following studies: skeletal muscle scanning in progressive muscular dystrophy; protection of thyroid gland and total body from the radiation delivered by radioactive iodine; film dosimetry of cobalt-60 beam radiations; stem-cell kinetics in x-irradiated mouse with shielded spleen or one leg; karyotypic features of persistent abnormal cells in fishermen exposed to fallout radiation in 1954. (H.L.W.)

24455 (NP-16722) PATHOLOGICAL EFFECTS OF THYROID IRRADIATION. Revised Report. (Federal Radiation Council, Washington, D. C.). Dec. 1966. 14p.

Therapeutic doses of x rays to the thyroid region of children have been followed after some years by the development of thyroid neoplasms. Whereas the percent of cases of malignant neoplasms is small, the proportion of persons irradiated who develop nodular thyroid disease can be extremely high. The incidence of radiation-induced thyroid disease is strongly dose dependent above 100 rads (thyroid dose). The shape of the response curve below 100 rads is unknown. X rays are probably as effective if not more so than iodine 131 in producing thyroid lesions for equal, average absorbed doses delivered to the gland at similar rates. An apparent greater effectiveness of x ray irradiation may be due to the higher dose rate used. Whereas it was formerly believed that the induction of thyroid tumors was enhanced by irradiation of tissues other than the thyroid itself, it now seems possible to explain variability in tumor induction in children on the basis of whether or not the gland was in the primary x ray beam. Radioactive iodine in amounts sufficient to deliver several hundred rads to the thyroid of the infant or young child has been shown to produce a high incidence of thyroid nodules. Radioactive iodine has been shown to be carcinogenic in some animals. No case of thyroid cancer clearly ascribable to it has been reported in man. (auth)

24456 (USNRDL-TRC-67-3) POSTATTACK FOOD AVAILABILITY AND ACCESSIBILITY: A CASE STUDY. Final Report. Billheimer, John W. (Stanford Research Inst., Menlo Park, Calif.). Apr. 1967. 145p.

An analytic technique designed to forecast the postattack availability and accessibility of critical foodstuffs in a single municipality is described. The described technique employs utilization charts, distribution diagrams, and seasonal inventory data to

provide quantitative models of the normal preattack flow of individual commodities to local consumers. Estimates of postattack commodity flow are obtained by applying appropriate damage assessment procedures to critical elements of the preattack distribution models. The techniques developed in the report are applied in a case study of the effects of a hypothetical attack on food availability and accessibility in San Jose, California. (auth)

24457 THE EFFECT OF HIGH PRESSURE OXYGEN ON THE EXPERIMENTAL TUMORS IN RATS TO RADIOTHERAPY. DIFFERENCES ON THE REGRESSION PATTERN OF THE SIZE OF TWO KINDS OF EXPERIMENTAL TUMORS. Egawa, Jun; Iida, Koyo (National Cancer Central Hospital, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1245-8(Dec. 1966).

Effects of three atmospheric pressures of pure oxygen on the irradiated solid tumors of femur of rats transplanted from Yoshida ascites hepatoma AH 130 and 4-Nitroquinoline-N-Oxide induced Donryu rat pulmonary carcinoma (Sato and Shimozato) were studied. AH 130 tumors to which 1500 R and 3000 R were delivered in three atmospheric pressures of oxygen showed a faster regression of the size of tumors and a higher cure rate, compared with controls. 4-NQO induced tumors, to which 1000 R, 1500 R and 2000 R were delivered, showed no difference between the groups which were irradiated in air and three atmospheric pressures of oxygen. Increase of body weight of rats was less in the animals which were irradiated in three atmospheric pressures of oxygen than the animals which were irradiated in air. Skin reactions of irradiated femur were heavier in the animal which irradiated in three atmospheric pressures of oxygen than those which irradiated in air. (NSA of Japan)

24458 X-RAY AND ADENOSINE TRIPHOSPHORIC ACID. PART III. (1). EFFECT OF X-IRRADIATION ON ADENOSINE TRIPHOSPHORIC ACID IN YOSHIDA SARCOMA. (2). INFLUENCE OF ADENOSINE TRIPHOSPHORIC ACID ON SULFHYDRYL GROUP IN YOSHIDA ASCITES SARCOMA. Nagai, Jun (Sapporo Medical Coll.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1145-52(Dec. 1966). (In Japanese).

In an attempt to rectify a discrepancy in the experimental methods in Part II, this study was carried out to elucidate the mechanisms of the protective effect of ATP against the damage of Yoshida sarcoma by x irradiation, which was previously reported in Part I. The results obtained were as follows; a comparison was made between the irradiated Yoshida subcutaneous sarcoma and the nonirradiated tumors at 30 minutes and 2 hours after local x irradiation with 1000 R. There were no significant differences in the amount of adenosine nucleotides and ^{32}P-incorporation into their respective fractions. Rats bearing Yoshida ascites sarcoma were injected intraperitoneally with ATP solutions 15 mg per 100 gm body weight. At 15 minutes after injection, a comparison was made between the ascites tumor cells collected from ATP-treated animals and that from nontreated groups. No significant differences were observed in the amount of total and nonprotein sulfhydryl compounds between them. From these data, it was concluded, that the mechanisms of protection of ATP against x irradiation on the mitosis of Yoshida sarcoma does not depend on a supplementary addition of ATP deficiency produced by x irradiation nor on the increase of SH-compounds following administration of ATP. It is a problem to be investigated further. (NSA of Japan)

24459 ACTION OF HIGHLY POLYMERIZED NUCLEIC ACIDS AND THEIR BASES ON THE SURVIVAL OF RATS THYMOCYTES IRRADIATED IN VITRO. Constantin, Therese (Institut de Recherches Scientifiques sur le Cancer, Villejuif, France). Compt. Rend. Soc. Biol., 160: 1828-32(1966). (In French).

The effect of nucleic acids and their bases on the survival of thymocytes x irradiated in vitro was investigated. The results showed that highly polymerized DNA and adenine were the most efficient restoration agents. Polymerized RNA had a less marked effect than DNA but the effect was appreciable. The mechanism of the restoration action is discussed. (tr-auth)

24460 OXYGEN EFFECT IN THE PROTECTION OF E. COLI AGAINST U.V. INACTIVATION AND MUTAGENESIS BY ACRIDINE ORANGE. Webb, R. B.; Petrusek, R. L. (Argonne National Lab., Ill.). Photochem. Photobiol., 5: 645-54(Aug. 1966).

The effect of oxygen on the radioprotective property of photodynamically active acridine orange dye against the action of uv light on Escherichia coli B/r/1, try$^-$ was investigated. Dose-response relations were described by the functions $\underline{S} = 1-(1-e^{-\underline{k}\underline{D}})^{\underline{n}}$ where $\underline{S}$ is the surviving fraction and $\underline{D}$ is the uv dose in erg/mm^2. For cells suspended in 5×10^{-6}M acridine orange (AO) in air, the radiation sensitivity $\underline{k}$ was reduced from 0.010 (erg/mm^2)$^{-1}$ in the absence of the dye to 0.0053 (erg/mm^2)$^{-1}$ in the presence of the dye. Under anoxia at this AO concentration, $\underline{k}$ was further reduced to 0.0015 (erg/mm^2)$^{-1}$. The oxygen effect ratio, k_{O_2}/k_{N_2} was 3.5 at this concentration of AO. Greater protection was observed in cells suspended in 2×10^{-5}M AO; the oxygen effect ratio was unchanged. No oxygen effect was detected in uv response in the absence of the dye. The value of $\underline{n}$ was reduced from about 12 with no dye to about 5 at dye concentrations of 5×10^{-6}M AO or more when oxygen was present. Under anoxia, in the presence of AO, $\underline{n}$ was further reduced to about 1.3. Atabrine, an efficient uv protective agent but an inefficient photodynamic agent, had no oxygen effect for protection against uv inactivation. Acridine orange protected against uv-induced reversion to tryptophan independence in E. coli WP2 to about the same extent as it did for inactivation. A similar oxygen effect was observed for both inactivation and mutagenesis. (BBB)

24461 DEFICITS IN IRRADIATION THERAPY FOR CARCINOMA OF THE LARYNX FOLLOWED BY SURGERY. Harris, Herbert H. (Baylor Univ., Houston, Tex.). Ann. Otol., Rhinol., Laryngol., 70: 463-75(June 1961).

Complications of radiotherapy followed by surgery in the treatment of laryngeal cancer in 23 cases are reported. With 220-kV x rays, 36 treatments were given over a period of 6 weeks; the total tumor dose varied between 6000 and 7000 R. When 2-MeV x rays were used and 20 treatments given, over 28 elapsed days, the tumor dose varied between 5000 and 6000 R. There were three cases with severe complications attributable to irradiation. Fistula and necrosis of cartilage occurred, with fatality in 2 of the 3 cases. The complications as a result of irradiation except in these three cases were not great. It is doubtful if the end results would have been better had surgery been performed initially on those in whom radiation necrosis took place. There was a high rate of either recurrence or lack of response to irradiation in these cases. The morbidity was relatively high in those who survived because complications developed. It was suggested that had surgery been the initial treatment the mortality rate may not have been so high. The larger the tumor and the field of irradiation, the more likely complications will result if surgery follows the irradiation. Thus by using as small a port as possible, when surgery does follow irradiation, complications can be minimized. There was little or no difference in the response of the tissues to surgery when 220 kV, as against 2 MeV, radiation was used if the tumor dose remained the same, or a comparable dose was given depending on the number of elapsed days and the total number of treatments. (BBB)

24462 A SIMPLE METHOD FOR OBTAINING A SIMULATED PHOTOSCAN FROM A DOT SCAN. Field, E. O.; Dick, C. E.; Moreman, K. (Royal Marsden Hospital, Surrey, Eng.). Int. J. Appl. Radiat. Isotop., 18: 329-31(May 1967).

The form of display described has most of the merits of a photoscan in facilitating visual interpretation, without the hazard inherent in photoscanning, that information may be irretrievably lost through undetected technical faults. (auth)

24463 RADIATION AND BURKITT'S LYMPHOMA. Davies, J. N. P. (Albany Medical Coll. of Union Univ., N. Y.). Lancet, 1: 214(Jan. 28, 1967).

The possible radioinduction of leukemia in patients with Burkitt's tumor treated by radiation is suggested. Lymphoblastic lymphomas with the same histological appearance and pattern of tissue and organ involvement as that seen in African children occur in Britain and the U. S. However, the disease in these temperate regions seems to differ because it ends more commonly as a leukemic state, an ending uncommon in Africa. The frequency with which this happens in the U.S. and Britain cannot be established from details of published cases. If it is substantiated that in the temperate region leukemia does develop more commonly than in African children with this disease, the reasons will require detailed examination. Before innate or disease-induced differences in host response can be invoked, it is pointed out, there is a difference in handling patients in the different regions that may be significant. Virtually none of the African children have undergone therapeutic irradiation (x ray or ^{60}Co) as is common in the history of patients in the U.S. and Britain. This is one of the forms of treatment used in most patients. One patient was irradiated at an early stage and leukemia supervened, whereas in a nonirradiated case the tumor nodules remained localized. Now that a lymphomatous disease similar to the Burkitt tumor has been described in cats, dogs, and other animals, it would be worth investigating to determine whether therapeutic irradiation in these animals is followed by a leukemic state. Meanwhile, it is worth considering whether irradiation should be avoided in the treatment of childhood lymphomas presenting the microscopical appearance of Burkitt lymphoma. Radiotherapy, at least of the jaw tumors in this disease, is reported to be unsatisfactory. (BBB)

24464 IRRADIATION OF THE LYMPH NODES OF THE COLON WITH RADIOACTIVE NITROGEN MUSTARD. Georgacopulo, P.; Stancanelli, V.; Motta, G. (Univ., Ferrara, Italy). Minerva Chir., 21: 4-6(Jan. 15, 1966). (In Italian).

A new method for irradiating lymph nodes containing metastatic

cancer cells was developed. The compound used was ^{35}S-labeled triethylenephosphoramide. It had a concentration in aqueous solution of 17 mg/ml and a sp act. of 0.96 mCi/ml (10.8 mCi/mmole). The dose used in patients was 1 ml. The β radiation produced by ^{35}S has an energy of 0.167 MeV and a tissue range of 0.3 mm. The radioactive agent was introduced into the lumen of the intestine at the approximate level of the tumor, to be taken up in the lymph nodes of that region. Autoradiographic studies of the distribution of the ^{35}S-labeled compound in a patient with cancer of the colon revealed its massive dissemination throughout the paracolonic lymph nodes. The results demonstrated that the radioactivity is rapidly and extensively distributed in the draining lymph nodes where local β radiation can be delivered to metastatic cancer cells. (BBB)

24465 DETECTION OF ALTERED CEREBRAL ARTERIAL BLOOD FLOW USING ^{99m}Tc PERTECHNETATE AND THE GAMMA-RAY SCINTILLATION CAMERA. Rosenthall, Leonard (Montreal General Hospital). Radiology, 88: 713-18(Apr. 1967).

Differences in blood flow between the two cerebral hemispheres may be discerned qualitatively by monitoring the head with a gamma-ray scintillation camera following a rapid intravenous injection of ^{99m}Tc pertechnetate. Cerebral vascular accidents can be detected immediately after the insult as an area of reduced perfusion. Neoplasms have a variable pattern, but the highly vascular types will usually show an increased perfusion in the hemisphere containing the tumor. (auth)

24466 SCANNING BREMSSTRAHLUNG OF ^{90}Y MICROSPHERES INJECTED INTRA-ARTERIALLY. Simon, Norman; Feitelberg, Sergei (Mount Sinai Hospital, New York). Radiology, 88: 719-24(Apr. 1967).

Scanning bremsstrahlung of beta-particle emitters within the body is feasible when ^{90}Y and ^{32}P isotopes are administered in therapeutic doses. The distribution of ^{90}Y microspheres intra-arterially injected into brain, liver, lungs, and kidney can be determined. Similarly, ^{32}P in body cavities and in bone can be located for important clinical information. (auth)

24467 ENDOLYMPHATIC THERAPY OF TUMOURS WITH PARTICULAR REFERENCE TO THE VX2 TUMOR IN LEPUS CUNCICULUS. Edwards, J. M.; Gimlette, T. M. D.; Clapham, W. F.; Rutt, D. L.; Kinmonth, J. B. (St. Thomas's Hospital Medical School, London). Brit. J. Surg., 53: 969-78(Nov. 1966).

Studies were conducted in rabbits with ^{32}P, ^{90}Y, ^{131}I, and ^{198}Au on the development of a radioactive compound for irradiating tumor cells in lymph nodes. Physical data on β-particle dosimetry are examined and the main physical characteristics of the isotopes are discussed. The total absorbed β-particle dose (rad) per $\mu Ci/g$ of tissue for an isotope fixed in the tissue is also shown. A table gives the dose at 0.5 cm from the surface of a 1-cm dia sphere, the β-dose at the center being taken as 100%. Both ^{131}I and ^{198}Au emit γ radiation as well as β radiation. The dose delivered to the lymph node by this means is only a small percentage of the β dose. However, at a point outside and close to the node the γ dose is comparable to the penetration dose of the high-energy β particle from ^{32}P and ^{90}Y. Tracer experiments were performed on animals, using small doses of ^{131}I incorporated in Lipiodol, to ascertain the fate of the isotope infused via the endolymphatic route. Calculations of the doses received by the tissues made in rad for the concentration of ^{131}I activity found in lymph nodes indicated that a high dose of radiation was achieved. When considered in relation to the doses actually given during the rabbit experiments of 5 mCi ^{131}I in 1 ml Lipiodol, doses up to 100,000 rad would be received by the lymph nodes. Lesser doses were received by other tissues; these doses are summarized. A trial was made of the effects of ^{131}I in Lipiodol injected directly into the lymphatic system of the rabbit as therapy for tumor-involved lymph nodes. Results of macroscopic and microscopic findings, and survival times, indicated that ^{131}I-Lipiodol was effective in treating nodes involved with microscopic-sized metastases. With homogeneous distribution achieved in nodes minimally involved, the dose in rad was massive, up to 100,000 rad, and more than sufficient to destroy the tumor metastases of the VX2 tumor. (BBB)

24468 APPLICATION OF RADIOGOLD (^{198}Au) FOR ESTIMATING THE HEPATIC BLOOD FLOW IN HEPATIC DISEASES. Sun, Tseng-i; Hsia, Te-chuan; Lin, Chao-chi; Wang, Tsan-shun; Yang, Yung-chang (Shanghai First Medical Coll.). Chung Hua I Hsueh Tsa Chih, 52: 157-60(Mar. 1966). (In Chinese).

Analytical results of applying radiogold for estimating the hepatic blood flow on 165 hepatopaths are reported. Of these patients there were 130 cases of chronic hepatitis, 25 portal cirrhosis, 6 cirrhosis due to schistosomiasis and 4 hepatic carcinoma. Also 22 normal persons were studied for comparison. The patient with an empty stomach 3 hours before the test had a gamma ray calculator fixed on his forehead between the eyes and 80 to 100 millicuries of ^{198}Au injected intravenously. (CFSTI)

24469 THE TREATMENT OF HODGKIN'S DISEASE. Kaplan, Henry S.; Rosenberg, Saul A. (Stanford Univ., Palo Alto, Calif.). Med. Clin. N. Amer., 50: 1591-1610(Nov. 1966).

Side effects and complications of radiotherapy for Hodgkin's disease and means whereby they can be prevented or minimized, are discussed. (TSS)

24470 EXPERIMENTAL STUDIES ON THE BIOLOGICAL RESPONSES OF MICE AND RABBITS TO THE SIMULTANEOUS ADMINISTRATION OF URANYL NITRATE AND ^{60}Co GAMMA IRRADIATION. STUDY 2. ON THE PROTECTIVE EFFECT OF THE Ca-EDTA AND CYSTEINE AGAINST THE ADMINISTRATION OF URANYL NITRATE AND SIMULTANEOUS GAMMA-RAY IRRADIATION. Fujii, Yoshio (Okayama Univ., Japan). Okayama Igakkai Zasshi, 78: 277-90(Mar. 1966). (In Japanese).

In mice exposed to γ radiation (650 R) over the whole body after intraperitoneal injection of uranyl nitrate (10 mg U/kg), cysteine (100, 200, or 400 mg/kg) was intraperitoneally injected 10 to 15 min before the treatment, or Ca-EDTA in the same doses after 2 hr. The combined effect of cysteine and Ca-EDTA was examined also. In rabbits irradiated with 800 R over the whole body after intravenous injection of uranyl nitrate (0.2 mg U/kg), cysteine (50 mg/kg) was intravenously injected 10 to 15 min before the other treatment, or Ca-EDTA (50 mg/kg) after 2 hr. The combined effect of cysteine and Ca-EDTA was examined also. As seen by mortality rate, and kidney histology of mice and nonprotein nitrogen in blood of rabbits, Ca-EDTA was effective while cysteine did not show any effect; nor was combination of Ca-EDTA and cysteine effective. (BBB)

24471 RADIOISOTOPES AND RADIOPHARMACY. Buechi, J. (Eidgenoessische Technische Hochschule, Zurich). Pharm. Acta Helv., 41: 449-66(1966). (In German).

The significance of radioisotopes in pharmacology and medicine are discussed, including their use in drug research because of their value as indicators, in research on problems of preparative chemistry, drug testing, and drug manufacturing. They are also valuable as radiation sources for the sterilization of drugs. Several radioisotopes have been developed for use as diagnostic agents. (TSS)

24472 RADIOISOTOPES AND RADIOPHARMACY. Buechi, J. (Pharmazeutisches Institut, Zurich). Pharm. Acta Helv., 41: 513-29(1966). (In German).

Uses of radioisotopes in pharmacology are discussed including the study of chemical reaction mechanisms, chemical analysis, studies of biological problems, medical uses of radioisotopes such as radioindicator studies, diagnostic methods, and therapeutic use, and use of radioisotopes to study the optimal use of pharmaceutical agents and carriers associated with administration of drugs. Listings of frequently used radiopharmaceuticals are discussed. A general discussion of compounding of radiopharmaceuticals includes their manufacture, important forms, studies with radioactive preparations, and compounding of radiopharmaceuticals in hospitals and medical clinics. (BBB)

24473 EFFECT OF CHLOROQUINE-DIPHOSPHATE ADMINISTRATION ON THE SKIN DAMAGE IN GUINEA PIGS CAUSED BY X-RAY IRRADIATION. Bielicky, Tibor; Zak, Miroslav; Bartak, Pavel; Malina, Lubor (Charles Univ., Prague). J. Invest. Dermatol., 47: 73-7(1966).

The protective effect of synthetic antimalarial drugs, e.g., chloroquine, hydroxychloroquine, and quinacrine, in some photodermatoses led to observations on the question of whether this protective effect is also present against ionizing radiation. Studies of the action of antimalarial drugs on pentose cycle activity in human erythrocytes in vitro and in vivo have shown that chloroquine diphosphate exerts a marked stimulating effect. Since the pentose cycle is inhibited as a consequence of radiation, it seemed possible that systemically administered chloroquine might have a favorable influence on tissue reparative processes in the course of radiation disease. Skin doses of 100 to 2000 R were given to guinea pigs. With increasing chloroquine doses diminishing radiation damage of skin occurred. The healing tendency, however, varied according to the time of chloroquine administration. A more progressive effect was achieved when chloroquine was administered 2 hr before irradiation. Possible ways in which this effect is caused are discussed. (BBB)

24474 THE TREATMENT OF CARCINOMA OF THE BREAST WITH RADIOTHERAPY: GEOMETRICAL DISTRIBUTION OF THE DOSE IN THE USE OF THE 17-MeV ELECTRON ACCELERATOR OR TELECOBALT APPARATUS. Heinzler, F.; Gremmel, H. (Univ., Duesseldorf). Roentgen Bl., 19: 455-8 (Sept. 1966). (In German).

The increased skin tolerance and decreased lung injury in the use of high-energy radiation for mammary cancer treatment as compared with low-energy x-ray therapy are discussed, and the

geometrical distribution of the dose in the treatment of carcinoma of the breast by ^{60}Co and by 17-MeV electrons and x rays is reported. The envelope-type of irradiation dose pattern obtained with the telecobalt apparatus represents a considerable improvement compared with conventional procedures. Since fast electrons have only a minimum effect on the pulmonary parenchyma, they are especially valuable in the presence of tuberculosis. The envelope-type of irradiation dose distribution produced by 17-MeV x-ray therapy constitutes the least damaging procedure for the patient because it combines a dose adequate at the focus with minimum side-effects on skin, bone, and lung. (BBB)

24475 IMMEDIATE EFFECTS OF X IRRADIATION ON THE INTESTINAL ABSORPTION OF GLUCOSE AND RADIOPROTECTION BY CYSTEAMINE. Lluch, M.; Ponz, F. (Univ. of Barcelona). Rev. Espan. Fisiol., 22: 109-14(1966).

The immediate effect of x irradiation on the intestinal absorption of glucose (2.77 mM) was studied in the rat, using the Sols and Ponz technique of successive absorptions in anesthetized animals. With 1200 and 1500 R the absorption at 1, 3, and 5 hr after irradiation was progressively inhibited, in comparison to the absorption before irradiation. With doses of 3000 R, on the contrary, after the same times an increase in the absorption of glucose was noted. The presence of a solution of cysteamine (0.5%) in the intestine during irradiation prevented the inhibition of the absorption of glucose due to irradiation. The radioprotective effect of cysteamine was complete under the conditions used. (BBB)

24476 IMMEDIATE EFFECTS OF X IRRADIATION ON THE INTESTINAL ABSORPTION OF GLUCOSE IN VIVO. Lluch, M.; Ponz, F. (Univ., Barcelona). pp 237-9 of IX Reunion Nacional de la Sociedad Espanola de Ciencias Fisiologicas, Pamplona, 1965. (In Spanish).

By the technique of successive absorptions, the absorption of D-glucose at a concentration of 2.77 mM was studied in situ in rat intestine. Rats received 1200-, 1500-, or 3000-R whole-body doses of x rays. The 1200- and 1500-R doses caused a decrease in glucose absorption, which reached a maximum of 39% by the 5th hr after irradiation. A significant decrease of 20% was noted within 1 hr of 1500-R irradiation. In contrast, glucose absorption was significantly increased by 3000-R irradiation, the maximum rise of ~25% being noted 3-hr postirradiation. Addition of cysteamine at a concentration of 0.5% prevented the inhibitory effect of 1200 R and the enhancing effect of 3000 R on glucose absorption from rat intestine. (BBB)

24477 RADIOPROTECTIVE AND CRYOPROTECTIVE PROPERTIES OF DIMETHYL SULFOXIDE IN CELLULAR SYSTEMS. Ashwood-Smith, M. J. (Medical Research Council, Harwell, Eng.). Ann. N. Y. Acad. Sci., 141: 45-62(Mar. 15, 1967).

The ability of dimethyl sulfoxide (DMSO) to protect a variety of cells from the damaging effects of freezing and thawing and from very low temperatures is discussed. The mechanism of the modification of x-ray induced damage in cells and whole animals when DMSO is present before and during exposure to radiation is also discussed. (B.H.S.)

24478 EFFECT OF DMSO AND THAM ON IONIZING RADIATION IN MICE. Gollan, F. (Veterans Administration Hospital, Coral Gables, Fla. Univ. of Miami, Coral Gables, Fla.). Ann. N. Y. Acad. Sci., 141: 63-4(Mar. 15, 1967).

The radioprotective effects of tris(hydroxymethyl)aminomethane (THAM) and dimethyl sulfoxide (DMSO) in mice was investigated. Mice were irradiated with 900 R ionizing radiation after intraperitoneal injections of DMSO and THAM or topical application of DMSO. The percent survival in each group was determined. It was found that at 1 ml of 0.3 M THAM (pH 7.9) only 13.3% of 30 mice survived; at 10 gm DMSO per kg body weight 83% of 98 mice survived; and when DMSO was topically applied in a 75% solution, 67% of 70 mice survived. (B.H.S.)

24479 FAST NEUTRON BEAM RADIOTHERAPY. STATUS AND PROSPECTS. Andrews, J. Robert; Hollister, Herbert (Georgetown Univ., Washington, D. C. Kaman Aircraft, Inc., Colorado Springs, Colo.). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 99: 954-61(Apr. 1967).

Radiobiologic reasons for studying the clinical applicability of fast neutron beam human cancer radiotherapy are discussed. The spatial requirements of dose distribution for human cancer radiotherapy can be met by a 14 MeV monoenergetic fast neutron beam. It has been shown that adequate collimation can be achieved in a 50 cm. length and that at this distance a generator producing 10^{12} neutrons/sec will deliver a clinically useful dose rate at the patient. It has also been shown that such a generator having a target life of approximately 100 hours can be constructed using existing technology. (auth)

24480 USE OF DMSO FOR THE TREATMENT OF POST-IRRADIATION SUBCUTANEOUS PLAQUES. Frommhold, W.; Bublitz, G.; Gries, G. (Auguste-Viktoria-Hospital, Berlin). Ann. N. Y. Acad. Sci., 141: 603-12(Mar. 15, 1967).

The effect of topical applications of DMSO on radioinduced subcutaneous fibroses after telecobalt therapy was investigated in a selected number of patients. In all cases, 90% DMSO was used as a liquid or gel. It was applied with a cotton tip applicator and the swabbed area was allowed to air-dry. Doses in the subcutaneous tissues exceeded 900 R as soon as a focal dose of 6000 R was aimed at two opposite fields (lymph nodes) on the pelvic wall. After a period of treatment from 3 to 4 mo, laboratory investigations showed no pathological deviations after termination of treatment. The histological pictures from various patients revealed a regression of the sclerosing process after treatment with DMSO. Especially in the lower layers where previously the increase in density of the fibers and the disappearance of the spaces between them was particularly marked before treatment, an isolation of fibers again nearing normality and a restitution of the fibers was noted. Also, the sclerosed islets of fibrous tissue within fat cell layers seemed to show a decrease in density of the fibrous texture. (B.H.S.)

24481 THE EFFECTS OF THE ADDITION OF MANGANESE DIOXIDE TO MEDIA ON THE VIABILITY OF BACTERIA DAMAGED BY X-RAYS, PHENOL, AND RADIOMIMETIC AGENTS. Harris, N. D.; Whitefield, M. (Chelsea Coll. of Science and Tech., London). J. Pharm. Pharmacol., 18: Suppl., 33S-38S(Dec. 1966).

Suspensions of two strains (B/r and II) of Escherichia coli were counted before and after damage by phenol, x rays, and radiomimetic substances on nutrient agar that was treated in various ways with manganese dioxide. Suspensions of cells were diluted in 0.05M phosphate buffer at pH 7.0 before exposure, and were irradiated in shallow layers. The irradiation times for 99% mortality were 20 min (about 50 Krad) for strain B/r and 12 min (about 30 Krad) for strain II. With untreated organisms, only strain B/r grown on the medium layered with 0.4% MnO_2 gel gave counts significantly higher than the appropriate control, all other counts showing a nonsignificant difference from the appropriate control. With phenol-treated organisms the strains varied markedly in their responsiveness, and modification of the medium produced significant effects. Strain II showed higher counts on all media containing MnO_2 and the latter was more effective in the layered media than when added to normal medium. Strain B/r behaved in a similar way in that the inclusion of MnO_2 was always favorable, except that 0.1% MnO_2 in the medium was as effective as layering the nutrient medium with 0.4% MnO_2 gel. When organisms were exposed to x irradiation, there were no significant differences from the appropriate controls when MnO_2 was present. Chlorambucil-treated E. coli, like untreated ones, were insensitive to MnO_2. After treatment with dimethyl busulfan, suspensions were influenced to a greater extent by media modified with MnO_2 than were cells damaged by chlorambucil. Significant beneficial effects were observed with strain II counted on media layered with 0.4% MnO_2 gel and with strain B/r on media layered with either concentration of MnO_2 in agar gel. Thus the inclusion of MnO_2 in media could result in increased counts of suspensions of E. coli after exposure to certain lethal agents. This beneficial effect was not due to the removal of peroxide from the media. It is possible that the MnO_2 adsorbed toxic substances, having effects similar to those noted with ferrichloride and activated charcoal. (BBB)

24482 CORNEAL XANTHOMAS IN CHILDHOOD. Liebman, Sumner D.; Crocker, Allen C.; Geiser, Clementina F. (Children's Hospital Medical Center, Boston). Arch. Ophthalmol. (Chicago), 76: 221-9(Aug. 1966).

Use of x radiation and ^{90}Sr β radiation to treat corneal xanthomas in two children is described. In the first case 100-kV x-ray therapy was given to xanthomas on the anterior abdominal wall (200 to 400 R) without definite effect. When the corneal lesions were progressing, radiotherapy was given to each eye as well (10 kV), 450 R to each cornea at the age of 4½ years and another 440 R 3 months later. The episcleral and corneal xanthomas continued to enlarge and extend centripetally. Because of the imminent threat of blindness, a new effort was made to treat the lesions with radiation therapy. Strontium-90 β radiation was administered in 6 weekly treatments of 100 Rep each at the age of 7 yr, and 4 treatments at the age of 8 yr were given over both corneas, again with indeterminate results. A pseudopterygium formed inferiorly in the left eye; the central window there became progressively more opaque until no clear cornea remained. In the second case β radiation with a ^{90}Sr applicator was administered over the corneal xanthoma, with a total of 6000 Rep delivered in a series of weekly treatments over a period of 2 months. During the period of radiation therapy no change was observed in the treatment lesion, and

two new episcleral yellow nodules appeared. Two months after the radiotherapy, the corneal lesion was considerably smaller and paler, and further improvement occurred in another month. There was some evidence that the β radiation aided in the involution of corneal xanthoma. (BBB)

24483 ROLE OF DISULPHIDE BONDS IN THE RESISTANCE OF BACILLUS CEREUS SPORES TO GAMMA IRRADIATION AND HEAT. Hitchins, A. D.; King, W. L.; Gould, G. W. (Unilever Research Lab., Sharnbrook, Eng.). J. Appl. Bacteriol., 29: 505-11(Dec. 1966).

Bacillus cereus PX spores were treated with thioglycollic acid in order to reduce at least 10 to 30% of the spore disulfide bonds to thiol groups. Treated spores were still viable and sensitive to lysozyme but remained resistant to the effects of γ radiation and heat. Neither treated nor untreated spores were radiosensitized by reagents that are known to block thiol groups. Spores were irradiated in the presence of p-chloromercurobenzoate (PCMB) or N-ethylmaleimide (NEM); compounds known to radiosensitize some vegetative bacteria. Neither AMB nor NEM sensitized untreated or treated spores to 0.4 mrad of γ radiation; this was checked further by irradiating spores at a number of dose levels in the presence of 1 mM iodoacetamide (IAM). The radiation dose/survivor curve for spores of B. cereus PX was similar to that for spores of B. megaterium: a small shoulder followed by a logarithmic decline. If spore disulfide bonds were responsible for resistance to irradiation it was likely that treatment of spores with thioglycollic acid would have had some effect on the survivor curve. However, no such effect was found and, since thiol-blocking reagents only slightly affected the radiation resistance of thioglycollic acid treated spores, it was shown that thiol groups of spores were not radioprotective. (BBB)

24484 RADIOACTIVE ISOTOPE PANCREATOGRAPHY. PRINCIPLES AND DISCUSSION OF A METHOD. FIRST RESULTS. Van Vaerenbergh, M. Jr.; Van Vaerenbergh, P. M.; Demeulenaere, L.; Yvergneaux, J. P.; Barbier, F. (Univ., Ghent). Ann. Radiol., 9: 593-601(1966). (In French).

Since no simple and direct method is available for the assessment of form and function of the pancreas, the use of methionine-labeled with radioactive selenium was investigated. Using the examination scheme advocated by Sodee, satisfactory scintigraphs in 27 out of 35 cases were obtained. In 12 of these latter cases, laparotomy verified the findings and confirmed the validity of the scanning. In spite of the limits of the method at present, pancreatography allows definitive conclusions to be reached concerning morphology and function of the pancreas. Even when techniques of scanning are perfected the differential diagnosis between pancreatitis and carcinoma will depend on clinical, biological and scintigraphic data as a whole. The encouraging results mean that routine usage of this direct and relatively simple examination can be contemplated. (auth)

24485 RENAL SCANNING WITH FERRO-^{99m}Tc-COMPLEX. PART II. TISSUE DISTRIBUTION AND BIOLOGICAL BEHAVIOR. Kazem, I.; Gelinsky, P. (Institut fuer Nuklearmedizin des Deutschen Krebsforschungszentrums, Heidelberg. Univ., Heidelberg). Nucl.-Med., 5: 409-20(1966). (In German).

The biological behavior of ferro-^{99m}Tc-complex is studied in experimental animals and human subjects. The results of tissue distribution of the ^{99m}Tc and ^{59}Fe in a double tracer technique are given. The three-component blood disappearance curve in rats as well as the whole-body counter measurement in man are analyzed. The mechanism of the specific concentration of the ^{99m}Tc activity in the renal tubules is discussed, and the advantages of this preparation for renal scanning in comparison to other preparations are given. (auth)

24486 THREE-ISOTOPE METHOD FOR DIFFERENTIATION OF FUNCTIONAL HETEROGENEITY OF THYROID GLAND TISSUE. Vohnout, S.; Roehling, S.; Soumar, J. (Forschungsinstitut fuer Endokrinologie, Prague). Nucl.-Med., 5: 373-9 (1966). (In German).

For repeated scintigraphic studies of thyroid function a triple isotope method is proposed which reduces considerably the period between two successive tests. Iodine-125 is used for the first and ^{131}I for the second scan while ^{132}I is employed on both occasions for the quantitative control of thyroid iodine uptake. All three isotopes can be used simultaneously if a pulse height analyzer is used. (auth)

24487 MAMMARY NEOPLASIA IN PARTIAL-BODY-IRRADIATED RATS TREATED WITH AET. Shellabarger, Claire J.; Schmidt, Robert W. (Univ. of Michigan, Ann Arbor). Radiat. Res., 30: 507-14(Mar. 1967).

When AET was combined with 400 R of anterior body x irradiation to 42-day-old female rats, the AET-treated animals lived longer than similarly irradiated, nonprotected littermates. Mammary neoplasia was much more prevalent in the irradiated portion of the animals than in the shielded, posterior portion. AET did not change the incidence of rats with mammary neoplasma, nor the total number of mammary neoplasms of various types when calculated on a rat-day at risk basis in the irradiated area, nor the incidence of mammary neoplasia in the shielded area, nor the incidence of other neoplasms in either area. The failure of AET to modify this scopal, neoplastic response was contrasted to previous reports that chemical radioprotective agents did modify the neoplastic response to total-body irradiation. It was suggested that, where these agents do act to modify the neoplastic response to irradiation, the modification may be at a site far removed from the interaction of the radiation and the tissue that is to develop neoplasia. (auth)

24488 SYNTHESIS AND RADIOBIOLOGICAL STUDY OF GAMMA-ISOTHIURONIUM BUTYROAMIDINE. Robev, S.; Pantev, T. (Inst. of Radiology, Sofia). Compt. Rend. Acad. Bulg. Sci., 19: 1039-41(1966).

The procedure used to synthesize γ-isothiuronium butyroamidine is presented. The radioprotective properties of the newly-synthesized substance were evaluated using four groups of white female mice ($CC_{57}W$), average weight 25 ± 2g. Eighty animals were administered intraperitoneal injections of a 1% aqueous solution in doses of 100, 150, 200, 300, and 400 mg/kg body weight; the LD_{50} was found to be about 325 mg/kg body weight; and the maximum tolerable dose was about 200 mg/kg. Test groups of 30 animals each were administered 160 mg/kg body weight of cysteamine or 200 mg/kg of γ-isothiuronium butyroamidine; at 15 min postinjection the animals were exposed to a 735-R dose of radiation. In the amidine-protected group, 83% of the mice survived; cysteamine-protected, 94%; and controls, 3%. Results corroborated the pronounced radioprotective properties of amidine compounds and underscored the substantial intensification of the radioprotective effect when an isothiuronium group was present at the third position in the aliphatic chain. It was concluded that the radioprotective activity of isothiuronium amines was directly connected with the primary isothiuronium structure and not with their potential ability to produce substances containing SH groups. (B.H.S.)

24489 A RATIO-SUBTRACT DEVICE FOR DETECTING SELECTIVE LOCALIZATION OF ISOTOPES IN CLINICAL SCINTISCANNING. Burn, G. P. (Radcliffe Infirmary, Oxford); Cottrall, M. F.; Field, E. O. Brit. J. Radiol., 40: 62-5(Jan. 1967).

An electronic system is described for obtaining scans of organs in the presence of a high background activity from the blood. The apparatus, which can be incorporated into any conventional clinical scintillation scanner, depends on the use of a second marker isotope with which the background activity is monitored. Pulses generated by the detector pass through two pulse height analysers in parallel, set at the respective photopeak energies of the principal and marker isotopes, and are converted into currents by two rate meters. The two currents, which can be adjusted independently, are subtracted from one another and the net current used to alter the color of a dot colorscan or to vary the intensity of the light source of a photoscan. The apparatus can also be used for pancreatic scanning with ^{75}Se-methionine, by monitoring the ^{75}Se contained in the liver with the aid of colloidal ^{198}Au. This was tested by means of a simple phantom representing the liver and pancreas. Reproductions of the colorscans are presented showing that the background activity of the liver can be obliterated without affecting the activity recorded from the pancreas. (auth)

24490 THE EFFECT OF SPLENIC X-IRRADIATION ON THE FERROKINETICS OF CHRONIC LEUKEMIA WITH A CLINICAL STUDY. Awwad, H. K.; Badeeb, A. O.; Massoud, G. E.; Salah, M. (Univ. of Alexandria, Egypt). Blood, 29: 242-56(Feb. 1967).

The usefulness of splenic x-irradiation in the palliative treatment of chronic leukemia is illustrated by the results obtained in the treatment of 18 patients. This form of therapy was generally followed by reduction in organ size, improvement in blood levels, and control of associated anemia. Abnormalities of iron kinetics were defined in nearly all patients prior to therapy. A second ferrokinetic study was performed after remissions were induced by splenic irradiation. In the majority of patients, some evidence of increased red cell sequestration in the spleen could be demonstrated before therapy. The reaction of the erythropoietic tissue to this hemolytic process varied. In a number of patients with chronic lymphatic leukemia, there was an absolute hypoactivity. In the chronic myeloid group, erythropoiesis was either normal or slightly increased. In three cases of CLL with marked hemolytic activity, the erythropoietic activity was increased approximately twofold. However, in none of the anemic cases was erythropoiesis adequate to maintain a normal red cell mass. Ex-

tramedullary erythropoiesis was demonstrated in all patients of the myeloid group. (auth)

24491 RADIOPROTECTIVE EFFECT OF DIMETHYL SULFOXIDE IN RATS. Highman, Banjamin (Armed Forces Inst. of Pathology, Washington, D. C. National Inst. of Health, Bethesda, Md.); Hansell, John R.; White, David C. Radiat. Res., 30: 563-8(Mar. 1967).

Two series of young adult Sprague–Dawley rats were given 800 R of whole-body x irradiation 5 to 15 minutes following an intraperitoneal injection of physiological saline or dimethyl sulfoxide (DMSO). In the first study, 4 of 20 female rats given DMSO (4.5 gm/kg), and none of 20 given saline, were alive 30 days following x irradiation. In the second experiment, 6 of 12 males and 9 of 12 females given DMSO (4.5 gm/kg), but only 1 of 12 females and none of 12 males given saline, survived 30 days. DMSO lowered the body temperature of rats about 2°C in 2 hours, and this fall was not augmented by x irradiation. It is concluded that DMSO has a significant radioprotective action in rats and that this action is not due primarily to the hypoxia mechanism. (auth)

24492 KINETICS OF COLCHICINE-INDUCED HEMOPOIETIC RECOVERY IN IRRADIATED MICE. Brecher, George; Smith, Willie W.; Wilson, Shirley; Fred Sallie (National Inst. of Health, Bethesda, Md.). Radiat. Res., 30: 600-10(Mar. 1967).

The recovery of bone marrow and splenic hemopoiesis was studied in irradiated mice given colchicine either 2 days before or shortly after whole-body γ irradiation. The preirradiation treatment accelerates both marrow and splenic regeneration, with resulting increased survival due to early recovery of normal granulocyte levels. Postirradiation treatment accelerates splenic erythropoietic regeneration, but fails to improve marrow regeneration, resulting in persistent granulocytopenia and in death rates similar to that found in the controls. Colony-forming units (CFU) responded similarly. They recovered earlier in the marrow of the pretreated animals, but failed to do so in the marrow of mice that received colchicine after irradiation. In contrast, the time of recovery of splenic CFU was advanced with postirradiation treatment as well as with treatment given 2 days before irradiation. The observations presented add to the mounting evidence that either committed and noncommitted stem cells exist, or a single stem cell can undergo physiologic changes that alter its potentials for transplantability and differentiation. To decide between these alternatives will require extensive further exploration. (auth)

24493 MANNITOL IN CARE OF THE PATIENT TREATED BY RADIATION FOR CEREBRAL NEOPLASMS. Cioffi, F. A.; Pini, M. (Ospedale Maggiore, Trieste, Italy). Rass. Int. Clin. Ter., 45: 1003-14(Oct. 15, 1965). (In Italian).

Reactions in the central nervous system (CNS) following irradiation of cerebral neoplasms are described. An early reaction (24 to 36 hr postirradiation) consisted essentially of hyperemia and edema. A major reaction that occurred 2 to 4 weeks later was characterized by a hypertensive phase. A late reaction resulted from irreversible vascular changes in the brain; this reaction is often confused with tumor recurrence. Ten patients that had received 4650 to 5250 R of conventional x rays, 4500 R of 17.2-MeV x rays, or 4600 to 7100 R focal doses of ^{60}Co γ rays for brain tumors were treated with mannitol (20% solution containing 5% glucose). The mannitol solution was infused intravenously in doses of 1 g/kg body weight for an average period of 12 days after irradiation in each patient. Beneficial results on the patients' general condition and hematologic parameters were claimed. (BBB)

24494 MALIGNANT MESOTHELIOMA TREATED WITH ALPHA-METHYL HYDRAZINE (NATULAN) AND IRRADIATION. Falkson, Geoffrey; Jacobs, E. L. (Univ. of Pretoria). Med. Proc. (Johannesburg), 10: 452-5(Oct. 17, 1964).

A new and successful method for treatment of malignant mesothelioma, that is usually considered to be radioresistant, is described. Treatment with Natulan, a new cytostatic agent, and γ radiation (3600 C telecobalt unit) gave unexpectedly good results in one case, with remission of the tumor. The case was reported because of the remarkable response of malignant mesothelioma to chemotherapy combined with radiotherapy. (BBB)

24495 DEFINITIVE TREATMENT OF 536 CASES OF HYPERTHYROIDISM WITH ^{131}I OR SURGERY. Caswell, H. Taylor; Robbins, Robert R.; Rosemond, G. P. (Temple Univ., Philadelphia). Ann. Surg., 164: 593-9(Oct. 1966).

Indications for dosage, clinical results, and complications of ^{131}I treatment of 319 patients are reported. Principal indications for ^{131}I therapy were patients over 40, recurrent hyperthyroidism after operation, prohibitive surgical risk, sensitivity to antithyroid drugs, and refusal of surgical treatment. Average dosage for diffuse toxic goiter was 7 mCi, and for toxic nodular goiter 12 to 15 mCi of ^{131}I. The theoretical objection to ^{131}I on the basis of subsequent development of carcinoma or leukemia is discussed. Although isolated cases of thyroid carcinoma and of acute leukemia were reported, they cannot be considered as statistically significant. There is no evidence of genetic defects resulting in the birth of abnormal children in females who received ^{131}I for treatment of toxic disease as children. The significance of chromosomal abnormalities occurring in patients receiving ^{131}I is determined. However, the fact that the incidence of permanent myxedema rises steadily over a 10-yr period after therapy with ^{131}I demonstrates the long-term effect of ^{131}I on the thyroid cell. Permanent myxedema occurred in 15% of patients treated with ^{131}I in this study. It is likely that a more detailed evaluation of each patient would show a higher incidence. The low incidence of permanent myxedema in this group compared to other series may be explained partially by the low initial dosage of ^{131}I. Hypothyroidism can result in an insidious chronic disease characterized by fatigue, loss of mental acuity, excessive weight gain, and cardiovascular complications. It cannot be regarded as a minor, easily managed complication. (BBB)

24496 ADVANCES IN RADIOTHERAPY. Salzman, Ferdinand A.; Smedal, Magnus I. (Lahey Clinic Foundation, Boston). Practitioner, 197: 518-27(Oct. 1966).

Recent progress in radiotherapy is reviewed, the topics considered including modification of radiosensitivity by radiosensitizers, hyperbaric oxygenation, new knowledge on radioinduced biochemical lesions, use of high LET radiation, modification of fractionation, new applications of radioisotopes, megavoltage sources, and dosimetry. Based on experimental and theoretical considerations, several clinical approaches to the manipulation of radiosensitivity are being applied and are described. Developments in fast-neutron irradiation techniques are reviewed. Safety features introduced by after-loading technics in Ra implantation are considered, as well as the use of digital computers for treatment planning in multifield and moving field external radiotherapy and for estimation of the total spatial dose around radioactive implants. (TSS)

24497 THERAPEUTIC EFFECT OF VITAMIN B_6 ON THE RADIATION INJURY AND ITS MECHANISM. Abe, Mitsuyuki; Takahashi, Masaji (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 26: 903-9(Oct. 1966). (In Japanese).

The administration of 6 mg of pyridoxine 10 times at two-day intervals after irradiation increased significantly the survival-rate of irradiated mice. However, no therapeutic effect in the sense of an increase in the survival-rate could be observed when pyridoxine or pyridoxal-5-phosphate was given 5 min after irradiation. The mortality rate was increased by the administration of deoxypyridoxine hydrochloride after irradiation which induces a deficiency of pyridoxine in mammalian species. Recovery from radioinduced leucopenia was promoted as compared with untreated mice when pyridoxal-5-phosphate or pyridoxine was given after irradiation, although an initial decrease in leucocytes could not be prevented. Urinary excretion of xanthurenic acid increase markedly in irradiated mice. However, the increased amount of urinary xanthurenic acid was effectively diminished when pyridoxine was given three times every other day after irradiation. The therapeutic mechanism of pyridoxine may be tentatively assumed that it improves the radioinduced metabolic disturbances in living organs. (NSA of Japan)

24498 STUDIES ON THE EFFECT OF HYDROCORTISONE ON PULMONARY LESIONS INDUCED IN RATS BY X RAYS. Czarkowska, Daniela (Academy of Medicine, Lublin). Patol. Pol., 16: No. 4, 499-506(1965). (In Polish).

Wistar rats weighing 320 g underwent thoracic irradiation with 150-kv x rays at 500 R skin doses to produce a total of 3000 R. Some rats were injected daily with hydrocortisone (2 mg) for 99 days to evaluate the effect of the corticosteroid on radioinduced pulmonary fibrosis. In irradiated uninjected rats severe histologic lesions were noted which included partial or complete destruction of the walls of the interalveolar blood vessels, extravasation of blood into the alveoli, and occurrence of fibrosis. Hypertrophic changes were noted in alveolar epithelium and pleural endothelium. Hemosiderin granules accumulated in later stages in lung parenchyma. Hydrocortisone treatment tended to ameliorate proliferation of connective tissue elements in late fibrotic changes but tended to increase mortality because of an increased incidence of pneumonitis in steroid-treated animals. (BBB)

24499 HOW I TREAT ACTINIC AND SEBORRHEIC KERATOSES. Knox, John M. (Baylor Univ. Coll. of Medicine, Houston, Tex.). Postgrad. Med., 41: A129-30(Jan. 1967).

Treatment of skin lesions caused by uv and ionizing radiation is outlined. Early keratoses may be managed conservatively, by

lubricating the involved areas 3 or 4 times a day with petrolatum or other lubricant. The patient should avoid sun exposure or apply a sunscreen agent if exposure is unavoidable. Individual lesions may be treated with weekly applications of 20% podophyllin in tincture of benzoin, frozen with liquid N_2 or dry ice, or painted with 50% trichloroacetic acid. An effective treatment for multiple actinic keratoses is use of 1% 5-fluorouracil in propylene glycol, applied topically twice a day for 30 days. Advanced keratoses must be completely removed, before malignant degeneration occurs, by surgical excision or curettage followed by electrodessication. Dermabrasion improves actinically damaged skin and retards the development of new actinic keratoses. Techniques for curettage and electrodesiccation are described. Ionizing irradiation can produce postirradiation keratoses and should be used cautiously and conservatively, with both physician and patient adequately protected. These lesions are becoming less common. Treatment for postirradiation keratoses is the same as that for actinic keratoses. However, when severe chronic radiodermatitis accompanies the keratoses, skin grafting may be necessary. (BBB)

24500 INFLUENCE OF FLEMING'S LYSOZYME ON LEUKOPENIA DUE TO RADIOTHERAPY. CASE CONTRIBUTION. Ferri, G. G.; Pozza, F.; Calzavara, F. (Univ., Padua). Quad. Radiol., 30: 759-66(July-Aug. 1965). (In Italian).

Evidence is reviewed that lysozyme exerts a local and systemic radioprotective effect, particularly on leukocytes in patients undergoing large-field radiotherapy. This effect was tested clinically in 21 patients (13 with abdominal or pelvic tumors, 5 with mammary gland tumors, 2 with tumors in the neck region, and 1 with lung tumor). The patients received daily 150- to 300-R doses of 220- to 250-kV x rays and were injected intramuscularly with 250-mg doses of lyophilized lysozyme once a week. The lysozyme treatment was believed to have prevented leukopenia and anemia. In no case did the peripheral leukocyte level drop below 3500/mm^3, and the levels soon rose after completion of radiotherapy. In 2 cases allergic type reactions developed after lysozyme injections that readily responded to treatment with antihistaminics and corticoids. (BBB)

24501 TRACER DILUTION CURVES IN CARDIOLOGY AND RANDOM WALK AND LOGNORMAL DISTRIBUTIONS. Wise, M. E. (Univ., Leiden). Acta Physiol. Pharmacol. Neer., 14: 175-204(Dec. 1966).

The fits to radioactive tracer dilution curves by some mathematical probability curves are discussed. These fits are based on the triangle formed by the 2 tangents at the points of inflection on the rising and falling limbs. Lognormal, random walk, and γ curves with the same inflection triangle are compared, and lognormal and random walk curves for a whole range from nearly symmetrical curves (and triangles) to very skew ones. Tables for numerical analyses of observed curves in terms of random walk ones are given; these include the height ratios (of triangle to maximum of curve) and area ratios (of triangle to area under the complete curve), needed for estimating cardiac outputs. The known model is discussed for a Gaussian distribution of distances of injected particles along a linear stream, spreading out as they move with the stream. It is shown that this leads to two different random walk distributions. The concept of a distribution of passage times has to be redefined for a random walk model, when individual particles are changing places with one another. The central blood volume is redefined and derived in terms of the curve; the usual formula was found to be invalid for this model. (BBB)

24502 ON THE QUESTION OF TERATOGENIC INJURY OF THE FETUS BY X-RAY DIAGNOSIS. Schulte-Brinkmann, W. (Univ., Duesseldorf). Deut. Med. Wochschr., 91: 2209-12 (Dec. 9, 1966). (In German).

It is known that x-ray exposure during early pregnancy may produce anencephaly and marked malformations of the limbs in the fetus, but that the teratogenic effects of irradiation are less following exposure after the fourth month of pregnancy. Although it is still not known whether amounts of radiation of the order of a few rads can produce growth anomalies in humans, it should be assumed to be true until contrary evidence is found. The author discusses precepts that should be followed to avoid unanticipated injury to irradiation of the fetus during the first weeks of pregnancy, and reduction of the fetal dose by stray radiation. X-ray studies of the abdomen and pelvis should be made in women only after great consideration as to their being pregnant. The least possible amount of irradiation should be given, with photographs rather than fluoroscopy. If fluoroscopy is used, 90 kV at 1 mA should not be exceeded. Prefiltration of 120 to 150 kV and greater focus–skin distance reduces the dose, too. Sensitive films should be used. Exact positioning is important for reduction of dose to the fetus. (BBB)

24503 GENERAL PRINCIPLES OF PROTECTION AND TREATMENT IN NUCLEAR WAR. Quintane, G. Lille Med., 10: Suppl., 1091-5(1965). (In French).

Protective measures that can be employed to prevent or reduce injuries resulting from the immediate and late effects of thermonuclear explosions are outlined. The effectiveness of shielding against the irradiation at the time of detonation is discussed in terms of the energy spectrum of neutrons and γ rays produced. Protection against fallout radionuclides is also considered, and prevention of β burns and internal contamination examined in particular. Treatment of radiation injuries at various stages of severity is described. After heavy whole-body irradiation, rigorous asepsis is essential, with judicious use of antibiotics to control infections to which the irradiated subject is particularly susceptible. Treatment with blood and blood products may be required to prevent anemia and clotting disorders. The use of bone marrow transplantation is also considered. (BBB)

24504 STUDIES ON PHOTOELECTRONIC RESCANNING. Okawa, Haruo (Chiba Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 458-65(Aug. 1966). (In Japanese).

A photoelectronic rescanning has been designed as a new contrast accentuation method of the radioisotope area scanning. In this method, the once-scanned figure, being transparent on the uniform light box, is scanned by the collimated light sensing probe with a silicon solar cell. The rescan controller with an oscillator give the electric pulses of various levels according to the density on the figure, which are recorded through the multi-dot recording system. In order to get higher contrast amplification, rescanning visualization in color is devised, using the color recording method of color filter type in the fixed time counter method. In these methods the once-recorded scan figure can be automatically reproduced at any time, analyzed repeatedly at various cut-off levels of its density in the process of reproduction for contrast accentuation, without burdening a patient. With these methods the diagnostic property of the radioisotope area scanning has been actually improved on the various organs such as brain, liver, and pancreas. (NSA of Japan)

24505 OPERATIVE TREATMENT FOR POST-RADIATION DEFECTS OF THE CHEST WALL: REPORT OF SIX CASES. Latham, W. D. (Naval Hospital, San Diego). Amer. Surg., 32: 700-8(Oct. 1966).

The clinical and histopathologic picture of radiation injury is reviewed and the treatment of irradiation injury and chest wall defects is described. The typical postirradiation chest wall defect is seen in the postmastectomy female in her forties or fifties, who has had conventional x-ray therapy following radical mastectomy. She usually presents large areas of fibrosis with advanced skin changes, ulceration with infection, chronic drainage, and moderate to severe pain. Although many methods of treatment have been advocated, even including further x-ray therapy, it is now generally accepted that surgical intervention is the best method. The essence of the treatment of radiation injury is adequate excision of the damaged tissue and replacement with healthy, fat-bearing pedicle flap tissue. Stability of the chest wall is best obtained with the use of autogenous tissue but other materials may be used. The opposite breast offers the best source of flap tissue for coverage of chest wall defects. Other methods such as rotation flaps, tube-pedicle flaps, and abdominal jump flaps may be necessary under certain circumstances. Six cases are reported and the operative technic is illustrated. (BBB)

24506 UPTAKE OF RADIOACTIVE STRONTIUM(^{85}Sr) IN JOINTS DAMAGED BY RHEUMATOID ARTHRITIS MEASURED BY EXTERNAL COUNTING OF RADIATION. Holopainen, Toivo; Rekonen, A. (Central Hospital, Kuopio, Finland). Acta Rheum. Scand., 12: 102-11(1966).

Uptake of radiostrontium in the joints of 21 patients with rheumatoid arthritis was measured by external counting. The joints studied were 18 pairs of knees, 16 ankles, 19 wrists, 12 elbows, and 10 shoulder joints and, in addition, 22 pairs of finger joints. The patients were given the radioisotope as an intravenous injection of 20 μCi of ^{85}Sr. The uptake of ^{85}Sr in the joints was measured a week after the injection using a NaI(Tl) crystal connected with a photomultiplier and scaler. A lead collimator was used to limit the measuring field. The field of vision of the collimator on the skin was a circle 10 cm in dia. The dose of radiation to the bones was estimated to be about 0.5 R with the amount of radioisotope used, and the whole-body radiation exposure was about 0.2 to 0.3 R. The exposure in this study was thus comparable with bone x-ray examinations. The results were expressed as the ratio of counts (background subtracted) corresponding to the higher and lower ^{85}Sr uptake of the same pair of joints. When the uptake was symmetrical, the ratio was 1.0; when asymmetrical, the values were over 1. In the rheumatoid arthritis group, in 25 pairs of joints in which the contralateral joint was symptom-free,

the affected side gave a higher ^{85}Sr activity in all cases. The mean activity ratio was 1.45. The increase in ^{85}Sr uptake was correlated with the severity of the disease; the uptake was higher in an osteoporotic joint than in a normal joint. When the joint space was narrowed, the ^{85}Sr uptake increased further; the same was true of a joint with bone destruction. An increased uptake of Sr was observed prior to radiographic demonstration of bone or cartilage changes. Since Sr uptake reflects the turnover of Ca in the bones, it was concluded from the elevated Sr uptake values that the total accretion of Ca in joints affected by rheumatoid arthritis is accelerated. It was unclear whether the elevated activity values arose from the uptake of Sr in the bone, cartilage or synovium. However, preliminary measurements of tissue specimens indicated that bone played the greatest role, although there was appreciable Sr uptake in cartilage and synovium. (BBB)

24507 WHY NOT RADIOIODINE THERAPY FOR TOXIC NODULAR GOITER? Hamburger, Joel I.; Kadian, George; Rossin, Herbert W. (Wayne State Univ., Detroit). Arch. Internal Med., 119: 75-9 (Jan. 1967).

The advantages and disadvantages of ^{131}I treatment of toxic nodular goiter are examined on the basis of a literature review and results in 13 of the authors' patients. The use of radioiodine as the preferred therapy for toxic nodular goiter (TNG) is still controversial. Many investigators remain opposed to this approach. However, the use of large initial doses, between 20 and 50 mCi of ^{131}I, is gaining acceptance. In the past there has been concern for either exacerbation of the hyperthyroidism or the production of radiation thyroiditis following such therapy. The absence of such complications in patients with TNG has been stressed by investigators who use the larger doses. The prompt resolution of the hyperthyroid state with a single dose is not the only advantage of a large single dose. Since radioiodine distribution is particularly irregular in TNG, repeated doses by successively irradiating different areas of the goiter may contribute to the production of hypothyroidism. The dose of sodium iodine-^{131}I administered in the 13 cases described was determined on the basis of the size of the goiter and the 24 hr ^{131}I uptake. The range of doses administered was between 20 and 50 mCi. It was planned to administer a dose large enough to provide for a 24 hr thyroidal accumulation of a minimum of 8 mCi in the smaller glands ranging up to a maximum of 20 mCi in the largest glands. There were no adverse reactions to the therapy; neither radiation thyroiditis nor exacerbation of the hyperthyroidism was observed. All patients were relieved of hyperthyroidism with a single dose of ^{131}I. (BBB)

24508 X-RAY-INDUCED GLOMERULOSCLEROSIS IN RATS: MODIFICATION OF LESION BY FOOD RESTRICTION, UNINEPHRECTOMY, AND AGE. Wachtel, Louis W.; Cole, Leonard J.; Rosen, Victor J. (Naval Radiological Defense Lab., San Francisco). J. Gerontol., 21: 442-8 (July 1966).

Glomerulosclerosis occurs with increasing frequency in old rats, and it appears at an earlier age and in more severe form in x-irradiated animals than in normal animals, especially in unilaterally nephrectomized irradiated animals. The effects of kidney growth on the lesion was followed in the kidneys of Sprague-Dawley rats under various conditions of irradiation and growth. Weanling rats whose kidneys were irradiated directly with 1000 or 2000 rad developed glomerulosclerotic lesions in 2 months; 1-yr-old rats showed no evidence of lesions 2 months after irradiation with 2000 rad. In the weanling rat the rapidity of development and severity of the glomerulosclerotic lesions were increased by growth or enlargement of the kidney subsequent to irradiation and were slowed by growth retardation artificially produced through low food intake. The induction of glomerulosclerosis by x irradiation of the kidney is believed to be a result of damage to the kidney's vascular system and the effects of this damage are accentuated in the growing kidney. Irradiation of the endothelial cells of the vasculature of the weanling rat, when all cells are presumably at a peak of metabolic activity and cell turnover, would elicit severe damage to this system. (BBB)

24509 ORGAN VISUALISATION WITH ^{99m}Tc PREPARATIONS. Kazem, I.; Gelinsky, P.; Schenck, P. (German Cancer Research Center, Heidelberg. Univ. of Heidelberg). Brit. J. Radiol., 40: 292-300 (Apr. 1967).

Selected examples are presented to illustrate the potentialities of the use of ^{99m}Tc compounds for organ visualisation. Although no attempt has been made of the clinical evaluation, the additional information which can be gained by this means is both useful and impressive to those familiar with the technique. The purpose of this paper is to demonstrate the advantages of using ^{99m}Tc preparations. (auth)

24510 RADIATION REACTION IN THE LUNG AFTER CONTINUOUS AND SPLIT-COURSE MEGAVOLTAGE RADIOTHERAPY OF BRONCHIAL CARCINOMA. Holsti, Lars B.; Vuorinen, Pekka (Univ. Central Hospital, Helsinki). Brit. J. Radiol., 40: 280-4 (Apr. 1967).

Radiation reactions in the lungs were studied clinically and radiologically in 74 bronchial carcinoma patients treated by the fractionated dose method using 33 MeV x or ^{60}Co γ radiation and 33 similar patients treated conventionally by continuous high-energy radiation. The radiation reactions were milder after fractionated dose management and appeared two months later than after continuous radiotherapy. The observations show good agreement with the theoretical background of the fractionated dose method. (auth)

24511 CARDIAC SCANS WITH ^{131}Cs: FINDINGS CONFIRMED AT AUTOPSY IN FIVE PATIENTS. Himes, George E.; Kightlinger, James F.; Vick, David; Dunn, William J.; Malak, Joann (Flint Osteopathic Hospital, Mich.). J. Amer. Osteopath. Ass., 66: 131-45 (Oct. 1966).

The lack of uptake of ^{131}Cs by ischemic, infarcted areas of myocardium (giving "cold" spots on cardiac scans) was confirmed by pathologic examination of 5 hearts, and scanning of phantoms was performed to evaluate more precisely the value of ^{131}Cs cardiac scintigraphy. Cesium-131 acetate is nontoxic and innocuous in the dose range used (1.0 to 1.25 mCi). Cardiac scan frequently supplies the only firm evidence of the extent of myocardial damage. The low-energy (29.4 keV) γ rays of ^{131}Cs have been thought to be a drawback to scanning the viscera located deep within the body and particularly those located behind bones. Prior to autopsy of these cases, it was thought that there was significant absorption of the 29.4-keV γ rays by ribs and sternum, and point measurements of count rates over the ribs and intercostal muscles suggested that this was so. However, it was later apparent that the ribs are outlined as the result of the concentration of ^{131}Cs in the intercostal muscles with resultant greater count rate. The lateral and posterior cardiac scans, which were formerly not always satisfactory, were improved with the use of a low-energy collimator, which increased the count rate by a factor of 3. Good diagnostic scans are now obtained routinely, although heavily muscled men show the effects of the increased muscle volume. To test the effects of the absorption of ^{131}Cs γ rays, a model of the heart was made from agar in which ^{131}Cs (100 μCi) was dissolved and uniformly distributed prior to solidification. A human breastplate and ribs freshly removed at autopsy were superimposed and scanned with the same technique used in all cardiac scans. It was not possible to see the ribs or sternum on the scan. Only when the count rate differential was set at 5% was there a suggestion of bone absorption. The absence of ^{131}Cs in the muscle accounted for the difference in phantom and patient scans. It is concluded that cardiac scanning with ^{131}Cs is a useful procedure for the evaluation of all adult patients with cardiac disease to determine the extent and location of muscle loss in the myocardium. (BBB)

24512 AUTORADIOGRAPHY AND HISTORADIOGRAPHY IN A CASE OF INTRAGALACTOPHORIC INJECTION OF THOROTRAST. Gros, Charles; Girardie, J. J. Radiol., Electrol. Med. Nucl., 47: 47-50 (Jan.-Feb. 1966). (In French).

The fate of Thorotrast was followed after the injection into the milk ducts of a 72-yr-old patient about to undergo mammectomy because of an indurated tumor. Seventeen days after injection of 2 ml of Thorotrast, the surgically removed mammary gland was sectioned and examined by autoradiography. Radiography soon after injection of the contrast medium had shown its dispersion in the duct system. The autoradiographs examined at 8 days, 5 weeks, and 12 weeks after exposure showed the distribution of the ThO_2 particles. Numerous α-particle tracks were seen emanating from Th in the cytoplasm of the colostrum corpuscles. Less numerous tracks emanated from the cytoplasm of galactophoric cells. Numerous tracks were seen coming from the cytoplasm of histiocytes or macrophages in the interstitial tissue around the ducts. Contrary to what occurs with iodinated contrast agents, Thorotrast persists within the ducts and diffuses into the mesenchyme where it remains indefinitely. For this reason its use is contraindicated in spite of the greater clarity of the pictures obtained. The phagocytic power of colostrum corpuscles was greater than that of the galactophoric epithelial cells and similar to that of histiocytes which might provide further evidence for the theory of the histiocyte genesis of colostrum corpuscles. (BBB)

24513 MOPPING UP STRONTIUM. Brit. Med. J., 2: 1024 (Oct. 29, 1966).

Use of alginates, substances derived from algae, notably seaweeds, to prevent absorption of Sr from the alimentary tract is discussed. Alginates lower the absorption of radiostrontium from ligated intestinal segments of rats without inhibiting the uptake of Ca. Oral administration of sodium alginate in association with the short-lived isotope ^{85}Sr to human volunteers showed that a useful factor of reduction (8 to 10 times) in the uptake of Sr from gut to blood and thence to bone could be obtained. The factor of reduction

varied with the timing of administration, but even 20 min after ingesting ^{85}Sr the administration of sodium alginate could reduce uptake by about 3 times. The action of alginates varies with their composition, and it has been confirmed in experiments with rats that, unlike most other therapeutic agents used to reduce the uptake of radiostrontium, alginates do not diminish absorption of Ca. Moreover, an even greater protective effect is produced if the alginate used contains a high proportion of gluronic acid. About half the Sr in the body enters the bone in a little under 3 days; once the material is incorporated in bone its removal becomes very difficult. It is therefore worthwhile to define a method of prompt therapy which can act by inhibiting either primary absorption from the gut or resorption from intestinal juices during subsequent metabolism. A similar therapeutic approach applicable to intake of Cs has been tested with ferriferrocyanide (Prussian blue) as the inhibiting agent. (BBB)

24514 CURRENT PROBLEMS OF BONE MARROW TRANSPLANTATION. Fainstein, F. E. (Central Inst. of Haematology and Blood Transfusion, Moscow); Kiselev, A. E.; Kozinets, G. J. At. Energy Rev., 4: No. 4, 83-142(Dec. 1966).

This review deals with the current status of the comparatively new and, in many respects, still insufficiently studied problem of bone marrow transplantation. This is of great importance in the search for a rational system of combined treatment of the various processes resulting from the effects of ionizing radiations on the organism. The authors present experimental and clinical data confirming that the introduction of bone marrow auto- and homotransplantation into therapeutic practice has provided a wider scope for the use of radiotherapy and chemotherapy in the treatment of many serious pathological conditions. The review also summarizes data on other theoretical and practical approaches to the problem of bone marrow transplantation. These relate to the mechanism of action of myelotherapy, the peculiar features of the immunological reactions occurring in homotransplantation, possible ways of suppressing incipient immunological conflict, and problems of removing and conserving bone marrow. In their analysis of the materials available in the literature, the authors have also attempted to draw attention to some of the main lines that could be followed in subsequent work on the basic problems of bone marrow transplantation. (auth)

24515 HISTOCHEMICAL STUDY IN THE KIDNEYS OF RADIATION NEPHRITIS IN MAN. Dutta, L. P. (Medical Coll., Gauhati, India). Indian J. Pathol. Bacteriol., 9: 163-7(Apr. 1966).

Kidneys obtained from 6 cases of radiation nephritis in man were studied histochemically for acid mucopolysaccharides. It was found that in the early stages of the lesion mucopolysaccharide entered the glomeruli and lodged on the outer surface of the capillary wall. On the capillary wall itself some periodic acid-Schiff (PAS)-positive fibrillar material accumulated below the endothelium. As the glomerulus underwent atrophy and hyalinization, the mucopolysaccharide gradually disappeared and the whole capillary tuft became converted into a mass of fibrous tissue. The larger blood vessels also initially showed a mucinous proliferative thickening of the intima, rich in mucopolysaccharide, which was gradually replaced by fibroelastic tissue. A similar process, namely, the formation of mucopolysaccharide-rich edematous connective tissue, gradually replaced by mature fibrous tissue, was seen in the interstitial tissue of the kidney. This type of initial accumulation and later disappearance of acid mucopolysaccharides has been observed in healing wounds. It is suggested that the vascular changes produced by irradiation in the kidney play the major role in the development of hypertension and other clinical manifestations of the syndrome and the ultimate functional failure of the kidney. (BBB)

24516 EFFECT OF 2-AMINOETHYLISOTHIOURONIUM BROMIDE (AET) ON BLOOD COAGULATION. Praga, C.; Jean, G.; Ferrone, S. (Univ., Milan). Throm. Diath. Haemorrh., 15: 131-42(Jan. 31, 1966). (In French).

The effects of one of the most widely used radioprotective agents on blood coagulation was studied in view of the possible clinical use of this substance to prevent radiation injury. AET spontaneously converts to mercaptoethylguanidine (MEG) when dissolved in water at a physiologic pH. The sulfhydryl groups of MEG were shown to act on several pro- and anti-coagulant factors. Prothrombin-thrombin conversion was strongly inhibited, and this inhibition depended on the time of incubation of plasma with AET. The fibrinogen $\xrightarrow{\text{thrombin}}$ fibrin reaction, on the contrary, was inhibited only at higher AET concentrations. The inhibition of the antithrombin activity appeared to be directly related to the AET concentration. The increase of the thrombodynamographic value suggested an action of AET on the Laki–Lorand factor. The clot lysis time was augmented by AET only at high concentration. AET did not show any effect on clot retraction and blood platelet adhesiveness. These findings indicate that the use of AET as a radioprotective agent should be considered in terms of its effects of blood coagulation. (BBB)

24517 IMMUNORADIOACTIVE AGENT AGAINST CANCER. Ghose, T.; Cerini, Mildred; Carter, Maralis; Nairn, R. C. (Monash Univ., Melbourne). Brit. Med. J., 1: 90-3(Jan. 14, 1967).

Experiments were conducted in mice in attempts to develop a radioactively labeled anticancer antibody that would bind the cancer cells and specifically irradiate them lethally. The tumor and test system consisted of Ehrlich ascites tumor grown in Balb/c mice. To prepare antibody, rabbits were immunized by intramuscular injections of 1 ml of a 25% (w/v) saline suspension of viable Ehrlich ascites tumor cells emulsified with complete Freund's adjuvant. Radioactive labeling of serum was accomplished by a method whereby 19 mCi of carrier-free ^{131}I was used to label 1 mg of serum γ-globulin in 50 μl of phosphate-buffered saline. Purification of the radioiodinated globulin was carried out by gel filtration on Sephadex. The level of radioactivity obtained was about 2800 μCi/ml. Binding of the radioiodine-labeled γ-globulin to tumor cells was demonstrated by immunofluorescence, followed by autoradiography on the same sample, indicating that the labeling had no material effect on antibody activity. Tumor cells which had been incubated with iodinated antiserum showed no obvious microscopic changes. However, the absorbed specific antiserum with fresh guinea pig complement produced cytotoxic effects in 40% of tumor cells, including swelling, superficial bleb formation, crenation, fragmentation, and agglutination. Cell death was confirmed by the staining of damaged cells with the trypan blue. This cytotoxicity was detected only when antiserum and complement were together incubated with the tumor cells. Mice inoculated with Ehrlich ascites cells which had been incubated with the γ-globulin coupled with ^{131}I did not develop tumor, and remained healthy for several weeks, whereas control mice developed ascites tumor and died within 14 days of inoculation. (BBB)

24518 MEDICAL THERAPY AND SURGICAL THERAPY OF RADIODERMATITIS. Mela, Vittorio; Raso, Sergio (Ospedali Civili di Genova-Sampierdarena, Italy). Minerva Med., 57: 2582-8(July 21, 1966). (In Italian).

The pathogenesis of radiodermatitis following treatment of neoplasms is reviewed and 3 cases of such injury are illustrated to demonstrate medical treatment and surgical repair of the lesions. Surgical repair of severe chronic radiodermatitis is the only really satisfactory treatment; however, use of fibrinolytic preparations may be of value in some cases. In the early stages of radiodermatitis antibiotics should be applied topically. However, when necrosis is extensive and ulceration continuing, the possibility of carcinogenesis must be anticipated. In the first case described, a 10-cm ulcerated area of radiodermatitis had developed on the upper arm over a 20-yr period following x-ray and Ra therapy. Local treatment failed so that a skin graft from the abdominal region was used to cover the area of devitalized tissue, which was excised. Successful healing was obtained. In Case 2, irradiation of cancer of the ear had left areas of radiodermatitis on the ear which were treated by grafts from the back of the neck. In the third case, an ulcer on the cheek and necrosis of the underlying bone had followed x-ray therapy of an epithelioma. The sequestered bone was removed and a rotation flap graft applied to the cheek, with successful results. Illustrations are provided of the surgical techniques. (BBB)

24519 DETECTION OF VENOUS THROMBOSIS IN THE HUMAN BY MEANS OF RADIOIODINATED ANTIFIBRIN-FIBRINOGEN ANTIBODY. Reich, Theobald; Reynolds, Benedict M.; Healy, Martin; Wang, Michael C. H.; Jacobson, Julius H. (Mt. Sinai Hospital, New York). Surgery, 60: 1211-15(Dec. 1966).

A new method employing a radioisotope was developed and tested clinically for detection of venous thrombosis. Also described is a method for the preparation of radioiodinated antifibrin-fibrinogen antibody. Antihuman fibrin-fibrinogen globulin was concentrated from the serum of a horse immunized with fibrin prepared from human fibrinogen. After iodination with ^{131}I, free iodine was removed in a Dowex 8X resin column. Labeled antibody solution contained 35% of the added ^{131}I, of which 97% was protein bound. The labeling process caused 18 to 23% loss of antibody potency. The radioiodinated horse antihuman fibrin-fibrinogen globulin was sterilized by filtration through a Millipore filter. The test, which is described, for establishing the presence of asymptomatic or symptomatic calf vein thrombosis, involves intravenous injection of radioiodinated horse antihuman fibrin-fibrinogen globulin which then labels the thrombus. Using a radiation scintillation detector for localization of ^{131}I, symptomatic thrombus in the calf was confirmed, and asymptomatic thrombus was recognized up to 3 days before it produced findings on physical examination. The test yielded positive results even in thrombosis which had been diagnosed 1 week previously. (BBB)

24520 ROLE OF THE TIME OF IRRADIATION IN DERMATOLOGIC RADIOTHERAPY. Maggiora, A.; Lozeron, H. (Univ., Geneva). Dermatologica, 133: 21-7(1966). (In French).

A comparison was made of the effects of equivalent doses (600, 800, or 1600 R) of x rays of different energies given over different periods. These doses were given at 70 kV (3mA) or at 50 kV (25 mA). Thus, the influence of the duration of irradiation in the time limits usually used in dermatologic radiotherapy was tested on Vicia faba and on the guinea pig. It was shown that under the experimental conditions used the time of irradiation had no influence on epilation by x rays in the guinea pig. On the other hand, it appeared from the results that on the basis of other tests in the guinea pig (tests of epidermal thickening and of epidermal lesions) and on Vicia faba that x rays have a much greater effect when the dose is given over a short period than when it is applied for a longer time. The results of these experiments are discussed in terms of fractionation of irradiation in dermatological radiotherapy. The concept that it does not really matter if a dose of x rays is applied during a short time or during a longer time if the time of irradiation does not exceed 1 hr (at <200 kV) is questioned. (BBB)

24521 EVALUATION OF THE PALLIATIVE EFFECTS OF TREATMENT WITH THE 70-MeV SYNCHROTRON ON ADVANCED CARCINOMA OF THE BLADDER. Ferguson, David W.; Louie, Rose V.; Stone, Robert S.; Hinman, Frank Jr. (Univ. of California, San Francisco). J. Urol., 96: 62-4(July 1966).

Advantages of 70-MeV synchrotron radiation treatment of bladder cancer over ^{60}Co γ radiation are cited and its use in 83 patients is described. Therapy with multimillion-volt x-ray treatment seems the better of the two because of the ease with which the patient withstands therapy, the infrequency of complications, and the generally good palliative effects obtained. Theoretical reasons why better palliation might be expected are presented. The γ rays produced by the ^{60}Co units are equivalent to 3-MeV x rays which place the region of max absorbed energy at 0.5 cm below the body surface. In contrast, the 70-MeV x rays from the synchrotron place this max dose throughout a depth of 6 to 14 cm. Consequently, irradiation through a single entry port can be done instead of cross-firing from several ports and greater accuracy in placement of the dose can be obtained. The amount of normal tissue that must be irradiated is proportionally decreased. Therefore, the patient is better able to tolerate the therapy and there are fewer systemic reactions. Significant palliation was achieved in 70% of the 83 patients receiving full radiation therapy. The treatment was not well tolerated by 27% but there was no correlation between poor toleration of the treatment and the palliative results. General systemic tolerance to this radiation was good because the 70-MeV beam allowed a lower integral dose than conventional forms of radiation. Significant complications occurred in 14 of the 83 patients. There were 4 cases of urinary fistula and 4 cases of stricture of the rectum or rectosigmoid. In only 3 cases was a contracted bladder produced. The incidence of major complications was no different from that in other series reported. (BBB)

24522 TREATMENT OF ADVANCED RETINOBLASTOMA BY EXTERNAL IRRADIATION. Williams, I. G. (St. Bartholomew's Hospital, London). Proc. Roy. Soc. Med., 60: 189-96(Feb. 1967).

Radiation effects on optic tissues, including complications of radiotherapy, are described, particularly in relation to 46 patients treated by ^{60}Co teletherapy. With fractionated therapy in a single course up to 6 weeks, the immediate tolerance of surrounding tissues is so much greater than the ocular structures as not to affect dose considerations. Of greater consequence are the late changes of orthovoltage therapy, which include fibrosis of muscle, arrest of bone growth, and irradiation sarcoma. The various anatomical components of the eye exhibit a wide range in radiosensitivity. In this series a total dose varying between 500 and 1500 R was delivered in 3 to 4 weeks. Of the 46 patients treated by ^{60}Co 12 developed cataract. The literature related to induction of cataract in radiotherapy of retinoblastoma is reviewed. (TSS)

24523 BRAIN SCANNING OF CHILDREN USING BODY SECTION TECHNIQUES AND PERTECHNETATE-^{99m}Tc. Kuhl, D. E.; Pitts, F. W.; Tucker, S. H. (Univ. of Pennsylvania, Philadelphia). Acta Radiol., Diagn., 5: 843-54(1966).

As a scanning agent, pertechnetate-^{99m}Tc was used to keep radiation exposure of the child low, even when large doses of radionuclide were needed to increase the count rate. With high count rate, fine resolution collimation could be used, the scan speed increased, and multiple high quality images obtained in an acceptable period of time. The many advantages of pertechnetate-^{99m}Tc for use in children are given. The dose used was 200 μCi/Kg body weight for high count rate brain scanning of either children or adults. The total body radiation dose was approximately 120 mrads. Since the radiation dose was low, serial scanning at 6-month intervals was employed for follow-up examination of patients who had received radiotherapy to the brain. With the method described, diagnostic accuracy was good. Transverse section scanning added additional valuable information about the anatomic distribution of most intracranial lesions. The introduction of pertechnetate-^{99m}Tc for brain scanning has influenced instrument design. For example, the complexity of the research scanning system used could be reduced considerably by adapting its design to a very light weight detector system. The lower energy photon of ^{99m}Tc (140 keV) requires much less heavy shielding than higher energy emitters more commonly in use at present. (TSS)

24524 THERAPY OF SKIN TUMORS BY FAST ELECTRONS. Jansen, H. (Municipal Hospital, The Hague). Dermatologica, 133: 456-60(1966).

Advantages of 4- to 18-MeV electrons over conventional x-ray and γ-ray therapy of skin tumors are discussed, particularly from the viewpoint of protection of healthy tissues. In an electron accelerator all the electrons are given roughly the same speed, so they have potentially the same range in tissue. In the first one-third of their range, these fast electrons give off nearly all their energy to the tissue evenly. In the subjacent layers of tissue the electron penetration diminishes rapidly. An important advantage of this type of irradiation is the nearly complete homogeneity of the dose from the body surface over a certain thickness of tissue, while thereafter the dose reduces abruptly to zero. It is thus possible to irradiate a tumor homogeneously with sparing of the sound tissue underneath the tumor. The body surface receives no higher dose than the tumor. The surface dose of fast electron therapy can be reduced to $^3/_4$ as compared with conventional x-ray therapy. Conventional x rays also have the property of being absorbed strongly by bone tissue. On the surface and in the Haversian canals of bone absorption is 10 times higher than in the soft tissues above the bone. With high-dose conventional x-ray therapy of structures close to bone, necrosis of bone may occur. With high-energy β rays the absorption ratio bone : soft tissue is less than 2. Some examples of the use of fast electrons to treat skin tumors are cited, with attention to the radiation reactions noted and their prevention in normal tissue by specially constructed shields. (BBB)

24525 CURE OF A CASE OF RETICULOSARCOMA OF THE SOFT TISSUE OF THE THIGH IN SPITE OF SERIOUS COMPLICATIONS. LaRochelle, Jean-Louis (Hotel-Dieu, Quebec). Union Med. Can., 95: 713-7(June 1966). (In French).

Radioinduced complications in bone in an 11-yr-old boy are described. He had received ^{60}Co teletherapy on the thigh because of a reticulum cell sarcoma. The total dose of 5200 R was given over 13 days to the femoral diaphysis and 4000 R over 8 days at the level of the femoral neck. Soon afterwards he developed a fibrous myositis as an effect of irradiation. Two yr post-irradiation a pathologic fracture at the lower $^1/_3$ of the femur occurred. X rays showed decalcification of the bone, which is attributed to the previous irradiation. The fracture was repaired by nailing and bone grafting. Four and one-half yr after irradiation the tumor has not recurred and the patient is considered cured of the malignancy. (BBB)

24526 INFLUENCE OF VARIOUS COLI FACTORS ON THE LETHAL AND MUTAGENIC EFFECTS OF ULTRAVIOLET RADIATION. Howarth-Thompson, Sheila (Univ. of Otago, New Zeal.). Proc. Univ. Otago Med. Sch., 44: 5-7(Apr. 1966).

Colicine production in enterobacteria is determined by plasmids termed colicine factors. Colicine I factor (colI), originally derived from Shigella sonnei P9, confers resistance to the lethal effect of uv radiation when present in Salmonella typhimurium and Escherichia coli. Such colicinogenic bacteria also show increased response to the mutagenic effect of uv, as measured by the frequency of revision to prototrophy of auxotrophic mutants. ColI factors from other sources were tested for their effects on uv response in S. typhimurium LT2. The source of colI factors were 8 wild strains, 2 producing Ia colicines (M 6825 and 1M 2037) and 6 producing Ib colicines (1M 304, 1M 646, 1M 1168, 1M 1240, 1M 1905, and 2M 3070). Six of the 8 colI factors conferred resistance to the lethal effect of uv; the other 2, colIb-646 and colIb-1168, had no protective effect. These 6 factors also increased the yield of prototrophic revertants, as already described for colIb-P9; the other 2 had no apparent effect. Among resistant derivatives the number of revertants yielded at a given dose was highest for those showing the highest survival though when revertants were expressed as a function of the surviving population the frequency of reversion at any one dose was about the same for all derivatives. Two of the uv-protective factors, colIa-2037 and colIb-1240, and the two factors having no protective effect, colIb-646 and colI-1168, were tested for a further property of colIb-P9, the ability to promote transfer of chromosomal genes. In this respect they

were as effective as colIb-P9. Therefore, these properties of colIb-P9, reduction of the lethal effect of uv and increase in uv-induced reversion frequency, seem to be common to most coli factors from other sources. (BBB)

24527 MODEL INVESTIGATION OF THE MECHANISM OF RADIATION PROTECTION IN BIOPOLYMERS. Pisarevskii, A. N.; Andrianov, V. T.; Seleznev, A. F. (Belorussian State Univ., Minsk). pp 43-53 of Proceedings of the Second Tihany Symposium on Radiation Chemistry. Dobo, Janos; Hedvig, Peter (eds.). Budapest, Akademiai Kiado, 1967.

The radioprotective action of sulfur compounds, indolyl alkylamines (tryptamines), nitriles, and esters of gallic acid, on models of fourth-order structure of deoxyribonucleoprotein (DNP) and a liquid scintillator was investigated. The quenching factors for the substances studied were determined. The effects of radiation dose variation was investigated. No firm conclusions about the mechanism of the protective action was drawn but some theories are advanced. (B.L.M.)

24528 A NEW MICROAUTORADIOGRAPHY FOR HYDROPHYLIC AND LIPOPHYLIC COMPOUNDS LABELLED WITH SOFT β EMITTER. Kojima, Makoto; Murayama, Daiki; Shigematsu, Akiyo (Univ. of Hokkaido, Japan). Radioisotopes (Tokyo), 16: 161-6(Apr. 1967).

In order to reserve fixedly the hydrophylic and lipophylic metabolites labeled with soft β emitters in a light microscopic specimen, a new microautoradiography technique was devised. The technique, so called "Dry Method," is related to nuclear emulsion coating method as follows; (1) stripping the nuclear emulsion from the glass plate in glycerin water, (2) inverting and then mounting the emulsion on saranwrap-covered glass plate in the same water, (3) desiccating the emulsion at room temperature, (4) mounting the emulsion-saranwrap plate on the labeled specimen and then removing only glass plate, (5) expanding the emulsion on the specimen glass slide by slight exposure to the hot-vapour for a moment, in order to give a good contact, (6) keeping in a dark box at 4°C for an adequate period, (7) stripping only saranwrap piece from the emulsion in distilled water, (8) developing and fixing the emulsion, and (9) staining the specimen. Counting efficiency (silver grains/μ^2/μCi) was enhanced by this technique compared to the ordinary wet technique. The dry technique was not increasing physical and chemical fogging. Silver grains in Fuji ET-2F and in Fuji ET-2E, respectively, were plotted against tritium contents in arbitrary units after different short exposure times, using both dry and wet method. From the results obtained by dry method as well as wet method, the silver grains in ET-2F increased quite substantially with increasing contents, whereas the grains in ET-2E and ^{3}H contents were not parallel. (auth)

24529 NEWER METHODOLOGICAL APPROACHES TO STUDYING PROGRESSIVE MUSCULAR DYSTROPHY. I. VISUALIZATION OF MUSCLE INVOLVEMENT BY RADIOISOTOPE SCANNING. Nagai, Teruo; Furukawa, Tetsuo (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo), 16: 167-74(Apr. 1967).

Skeletal muscle scanning with I-125 MAA and ^{131}CsCl was developed for obtaining definitive data on the distribution of muscles involved in patients with progressive muscular dystrophy. With these labeled compounds delineation of the distribution of radioactivity corresponded exactly with the contour of each independent muscle mass, and the muscles involved were seen as cold area of decreased radioactivity. By serial scanning, evaluation of the progress of the disease is possible, and the scans might be useful in making decision regarding surgical procedure and rehabilitation program. (auth)

24530 PROCESS FOR MAKING A PREPARATION FOR THE TREATMENT OF THE SKIN. Setala, Kai M. E. (to Berner Osakeyhtio). Canadian Patent 749,929. Jan. 3, 1967. Priority date June 7, 1962, Finland.

The damage caused by radioactive isotopes on the skin is diminished by treatment with an ointment which converts such isotopes to a form insoluble in water or fats. In this condition they may be removed mechanically thus preventing absorption into the body. The basis of the preparation is sodium oleate purified so as to precipitate ^{90}Sr as an insoluble salt of a fatty acid. Ions which might compete in such a precipitation are carefully removed in the manufacturing and packaging technique described. (F.S.A.)

24531 RADIOACTIVE METHODS IN THE STUDY OF GASTROINTESTINAL BLOOD LOSS. Beeken, Warren L. (Hitchcock Clinic, Hanover, N. H. Dartmouth Medical School, Hanover, N. H.). 7p. (CONF-650112-2). DTIE.

From Symposium on Dynamic Function Studies with Radioisotopes, Boston.

The principles involved in quantitation and localization of gastrointestinal bleeding utilizing isotope techniques are presented. The methods are described and several applications mentioned. With a carefully conducted study and wisely interpreted results these methods can be of inestimable value in selected clinical and research areas. (auth)

24532 METHODS IN DRUG EVALUATION. Proceedings of the International Symposium held in Milan, 20–23 September 1965. Mantegazza, P.; Piccinini, F. (eds.). Amsterdam, North-Holland Publishing Co., 1966. 590p. $16.80; 60 Guilders. (CONF-650981–).

Methods for screening and characterizing new drugs are outlined and discussed. Critical evaluations of the applicability, limitations, and significance of the methods proposed for evaluating drugs used in fields such as cardiology, endocrinology, microbiology, neurology and psychology are presented. In the evaluation of radioprotective drugs that are administered before exposure to radiation, it was emphasized that the source of radiation; choice of the radiation dose, choice of the animal; method of drug administration, toxicity of the protective agent; type of protective agent and its mechanism of protection; and methods of assessment of protective agents that do not employ lethality as a criterion must be considered. Data on the radioprotective effects of intravenously and orally administered doses of cysteine and 2-mercaptoethylamine (MEA) against x radiation in mice are given. (B.H.S.)

24533 RADIOISOTOPE SKELETAL SURVEY. DeNardo, Gerald L.; Horner, Richard W.; Leach, Paul J.; Bowes, Donald J. (Stanford Univ., Palo Alto, Calif. Fitzsimons General Hospital, Denver). 23p. (CONF-660642-4). DTIE. Gmelin, AED-CONF-66-237-9.

From Society of Nuclear Medicine, 13th Annual Meeting, Philadelphia.

A rapid, simple method for the detection of localized bone disease has been developed using a whole body profile scanner and radioactive strontium. In 49 patients with malignant neoplasm the method has proved to be more sensitive than photoscanning techniques and the roentgenographic skeletal survey. In this limited group of patients no profile scan was normal in the presence of bone involvement. No falsely-positive results occurred. This radioisotope method for surveying the skeleton appears to be useful as a routine screening procedure for the earlier detection of neoplastic bone disease. (auth)

24534 MODIFICATION OF RADIATION-INDUCED MUTATION FREQUENCIES BY ANTIBIOTICS IN DROSOPHILA MELANOGASTER. Mukherjee, Ramendra Nath. Vancouver, B. C., Univ. of British Columbia, 1965.

Thesis.

The experiments reported in the present dissertation were undertaken to obtain further evidence for the possible roles of protein, RNA and DNA macromolecules in radiation-mutagenesis in Drosophila melanogaster. Several antibiotics were tested for their modifying effects on the frequency of radiation-induced sex-linked recessive lethals. Pre-radiation treatment with actinomycin D significantly reduces the frequency of induced mutations in germ cell stages assumed to include spermatids and spermatocytes. These results are consistent with the hypothesis of a role of proteins in the stabilization (repair) of radiation-induced premutational lesions. Puromycin, a specific inhibitor of protein synthesis is ineffective in the modification of induced mutation frequencies in Drosophila melanogaster. Mitomycin C, is itself a potent mutagen in all germ cell stages, peak mutagenicity occurring in spermatid stages. In combination with γ-rays, mitomycin C shows an overall additivity of effect. Mutation frequencies due to mitomycin C are not altered by pre- or concurrent treatment with actinomycin D. This may indicate a different mechanism for mutagenesis by mitomycin C and radiation. (auth)

Radiation Effects on Animals

Refer also to abstracts 24306, 24321, 24338, 24358, 24375, 24389, 24422, 24457, 24475, 24476, 24487, 24493, 24497, 24498, 24534, 24678, and 24695.

24535 (AD-638622) POSTIRRADIATION CREATINURIA IN MACACA MULATTA PRIMATES. Technical Report, June 1965–January 1966. Peters, I. G.; Hamilton, H. E. (School of Aerospace Medicine, Brooks AFB, Tex.). Aug. 1966. 12p. (SAM-TR-66-21). CFSTI $3.00 cy, $0.65 mn.

Macaca mulatta primates irradiated by ^{60}Co γ rays in three groups of four animals each to dose levels of 2,000, 4,000, and 6,000 rads showed marked creatinuria. Refinement of the fluorometric determination of creatine based on the reaction of ninhydrine with creatine in alkaline media was achieved. Interfering guanido compounds calculated on a creatine equivalence constituted from unmeasurable amounts to approximately 10% of the

total creatine in samples containing a small amount of creatine. (auth)

24536 (CONF-631008) PRENATAL IRRADIATION EFFECTS ON CNS DEVELOPMENT AND POSTNATAL BEHAVIOR. Conference Proceedings Held in Washington, D. C., October 4–6, 1963. Werboff, Jack (ed.) (Roscoe B. Jackson Memorial Lab., Bar Harbor, Maine). Contract AT(49-7)-1287. 140p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared for seven papers presented at this conference. (H.L.W.)

For abstracts of individual papers see: 24284, 24285, and 24537–24541.

24537 (CONF-631008, pp 2-36) REVIEW OF THE SOVIET LITERATURE ON PRENATAL IRRADIATION EFFECTS ON CNS DEVELOPMENT AND POSTNATAL BEHAVIOR. Furchtgott, E. (Tennessee Univ., Knoxville).

Various aspects of research on radiation effects on the central nervous system are discussed. Experiments with dogs and rats on the conditioned reflex, reversive conditioning, excitation, inhibition, and other phases of research are described. (H.L.W.)

24538 (CONF-631008, pp 37-47) RECENT SOVIET WORK ON ANTENATAL EFFECTS OF RADIATION AND A DISCUSSION OF FUTURE IMPLICATIONS OF GENERAL WORK IN THIS FIELD. Stahl, W. R. (Oregon State Univ., Corvallis).

Research in the area of residual damage following antenatal radiation is discussed. Results are given using standard Pavlovian terminology. Experiments with rabbits, rats, and dogs irradiated in utero resulted in morphological injuries and abnormal behavior. Other studies on disturbances in conditioned reflexes are reported. Emphasis is placed on radiation damage to the central nervous system. (H.L.W.)

24539 (CONF-631008, pp 48-81) PRENATAL IRRADIATION AND DEVELOPING CNS MORPHOLOGY. Brizzee, K. R. (Nebraska Univ., Lincoln).

Literature dealing with prenatal radiation effects on the central nervous system is reviewed. Studies on radiosensitivity of normal and tumor tissues, radioinduced deformities in frog embryos, effects of x radiation on chick embryos, effects of prenatal radiation on rabbits, and other studies are reviewed. (H.L.W.)

24540 (CONF-631008, pp 111-17) LOW DOSE AND ADMINISTRATION EARLY IN GESTATION EFFECTS. Kaplan, S. J. (Peace Corps, Washington, D. C.).

The following aspects of prenatal radiation effects on postnatal behavior are reviewed: effects of low doses of radiation on postnatal behavior; behavior of hamsters, mice and rats following exposure of embryos to radiation at various stages of gestation. (H.L.W.)

24541 (CONF-631008, pp 118-26) MEDIATING MECHANISMS OF PRENATAL IRRADIATION EFFECTS. Meier, G. W. (National Inst. of Neurological Diseases and Blindness, San Juan, Puerto Rico).

Discrepancies between morphological and behavioral studies in mammals are discussed; alterations in behavior were not seen concomitantly with gross morphological changes. The influence of the maternal organism on fetal development is discussed. The differences between males and females in behavioral response to prenatal irradiation are pointed out. (H.L.W.)

24542 (COO-119-235, pp 71-5) LIVER TUMORS IN BEAGLES INJECTED WITH ^{239}Pu. Taylor, G. N.; Hromyk, E. (Utah Univ., Salt Lake City. Radiobiology Div.).

The incidence of bile duct neoplasia in beagles injected with tetravalent ^{239}Pu very tentatively indicates that such tumors may be radiation-induced. Most of these growths were relatively small benign adenomas and were observed as incidental findings at autopsy. Two malignancies were found in 87 cases studied. (auth)

24543 (COO-1485-10) RATS, BOMBS, AND PARADISE: THE STORY AT ENIWETOK. Jackson, William B. (Bowling Green State Univ., Ohio). Mar. 7, 1967. Contract AT(11-1)-1485. 5p. (CONF-670316-1). Dep. CFSTI.

From 3rd Vertebrate Pest Control Conference, San Francisco, Calif.

The role of Polynesian rats (Rattus exulans) and roof rats (Rattus rattus) in causing human disease and crop damage in the Pacific Islands is discussed. At Eniwetok Atoll the only rodents present were Polynesian rats until after World War II when roof rats were brought in with supplies and equipment for the atomic test program. Following the test explosions, some islets of the atoll were denuded by heat, shock, and tidal waves. Initially radiation levels were high, but radioactive decay and dilution reduced the radiation hazard. The islands recovered and no genetic damage is apparent in either the plant or animal populations; the rats are normal and healthy and there are no apparent mutations. (H.L.W.)

24544 (EUR-3251.f) ETUDE DE L'EFFET DES RAYONNEMENTS SUR L'EMBRYON ET SES ORGANES IN VIVO ET IN VITRO. (RAPPORT SUR LES RECHERCHES EFFECTUEES AU COURS DE LA PERIODE DU 1-10-1965 AU 30-9-1966). (Study of Radiation Effects on the Embryo and its Organs in vivo and in vitro. Report on Research Performed From October 1, 1965–September 30, 1966). (College de France, Nogent-sur-Marne. Institut d'Embryologie Experimentale). Jan. 1967. Contract 039-64-10 BIOF. 20p. (In French). Dep. mn.

The research carried out during the year 1965-1966 was along three main lines, namely: Effects of radiations (chiefly x rays) on normal and cancerous cells and on embryonic physiology; Use of radiations as lesion-location or labelling techniques for detecting cell-migration and tissue-regeneration processes; Comparison between the effects of radiomimetic substances and those of x rays. (auth)

24545 (EUR-3263.e) BIOLOGICAL INDICATORS AND FIRST LESIONS AFTER IRRADIATION. Annual Report, July 1965–July 1966. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Mar. 1967. Contract 059-65-7 BIOB. 14p. DTIE.

Metabolism of DNA was studied in perfused liver and intestine from normal and x-irradiated rats. Deoxyuridine was found to be converted to thymidine and incorporated into DNA but also to be degraded rapidly. On the contrary, the conversion of deoxycytidine to deoxyuridine via CMP proceeds slowly in vivo, and this is the only reaction of DNA metabolism so far studied which limits the rate of formation of thymidine. Synthesis of nuclear RNA, one of the earliest signs of liver regeneration, was also studied during perfusion. Incorporation of orotate into nuclear RNA was found to increase during the perfusion of a regenerating but not during that of a normal liver. Catabolism of tryptophan via the kynurenine pathway takes place only in liver. Perfused liver 24 hours after irradiation with 1000 R degrades less tryptophan than normal liver, but incorporation of tryptophan into serum proteins is not decreased. Other studies reported concern the metabolism of serum proteins in irradiated rats. Using an airdrying method for meiotic chromosome preparation, the rates of chromosome rearrangements induced by irradiation of spermatogonial stages have been studied in mice. A first experiment was performed to study the radiosensitivity of different strains of mice; no difference was found 60 days after 400 R, 7.5 percent of the cells showing chromosome rearrangements in the five strains studied. Some experiments with increasing doses of x irradiation have shown that the rate of chromosome rearrangements increases regularly from 100 to 600 R given to spermatogonia. (auth)

24546 (NIRS-5, pp 25-7) CYTOLOGY AND MORPHOLOGY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported on the following studies: changes in PAS stainability of thymus tissue during recovery phase following the radiation-induced involution; effects of chronic irradiation on the spermatogonia of silkworm; effects of continuous low dose irradiation on mice; quantitative histologic analysis of the effects of continuous gamma irradiation on mouse testes. (H.L.W.)

24547 (NIRS-5, pp 28-46) PHYSIOLOGY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported on the following studies: effects of x irradiation applied to a part of the body on the ovary of the loach, Misgurnus angullicaudatus; effect of temperature on the rate of recovery from radiation-induced damage in the fish, Oryzias latipes; effect of x irradiation on fertility of the male of the fish, Oryzias latipes; inhibitory effect of x irradiation of embryos on testis formation in Oryzias latipes; effects of x irradiation given to a part of the body on mortality and histological damage of goldfish; effects of x irradiation on phosphatase activity in the intestine of the goldfish, Carassius auratus, at different temperatures; alterations in the functional state of rat adrenal following lethal and sub-lethal whole-body x irradiations; the role of reticular cells during the maturation process of erythroblasts; electron microscope studies of denucleation of erythroblasts; ^{59}Fe uptake in erythropoietic tissues in three strains of mice after irradiation; changes in blood water content, thrombocyte number, and blood serotonin content during the development of spontaneous mammary cancer in mice; blood serotonin content in x irradiated rabbits; effect of x ray doses on blood 5-HT content in mice; protection by shielding of exteriorized spleen; autoradiographic studies of ^{14}C-5-Hydroxytryptamine in mice; effect of different types of radiation on gaseous metabolism in mice; effect of internal irradiation on respiratory $^{14}CO_2$ patterns following ^{14}C-glucose administration in mice; influence of immunization with luteinizing hormone upon the anterior pituitary-gonad system of rats and its prevention by x irradiation and testesterone propionate administration; hematopoietic

stem-cell recovery after ionizing radiation; studies on x ray survival kinetics of cells during the growth cycle. (H.L.W.)

24548 (RA–16) STRALINGSDOSES IN 1962 ALS GEVOLG VAN RADIOACTIEVE NEERSLAG. (Radiation Doses in 1962 From Radioactive Fallout). Strackee, L. (Rijks Instituut voor de Volksgezondheid, Utrecht (Netherlands)). Jan. 1962. 23p. (In Dutch). Dep. mn.

From the assumption that after the Russian nuclear weapon test series in September and October, 1961, an amount of radioactive fission products is dispersed into the atmosphere equivalent 100 Megaton TNT fission energy, an estimation is made of the radiation doses to an individual as a result of the radioactive fallout to be expected in 1962. Doses from external radiation from the deposited fallout as well as doses from internal radiation as a result of the ingestion of contaminated food are taken into consideration. It appears that, for that part of the general public that is exclusively dependent on rainwater for consumption, the estimated doses are much lower than those which are acceptable by current international standards. An exception must perhaps be made for the dose to the gastro-intestinal tract from the consumption of rainwater. There is reason to believe that the real radiation doses in 1962 due to fallout will be appreciably lower than the values estimated in this report. (auth)

24549 (UCLA–12–616) INCIDENCE OF DISEASE AND CAUSE OF DEATH FOLLOWING SINGLE AND DIVIDED DOSES OF TOTAL BODY X-IRRADIATION IN RATS. Lamson, Baldwin G.; Billings, Marta S.; Bennett, Leslie R. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Jan. 1967. Contract AT(04-1)-Gen-12. 29p. Dep. CFSTI.

Female Long-Evans-Wistar f_1 hybrid rats were irradiated at age three months with 120, 240 or 480-R x radiation in either single or divided whole-body exposures. Life expectancy was shortened at all periods of life at all three dose levels. Rate of body weight gain was suppressed during the first year of life and thereafter. External tumors and bloody vaginal discharge increased in frequency and was dose dependent. A threshold for greying occurred between 120 and 240-R. Dose fractionation protected against greying, epilation, skin ulcers, bloody vaginal discharge and cataracts; the incidence of external tumors was increased. Epilation and external tumors both appeared significantly earlier following irradiation. Onset of greying of hair was delayed by dose fractionation. The diseases observed were sufficiently age dependent so that rats with these diseases lived longer than those without these conditions. Irradiated rats at autopsy had more widespread inflammatory changes, more large benign tumors, and more multiple tumors than controls. Incidence of malignancy was not altered in this experiment. The incidence and time of appearance of observed disease in irradiated rats did not measure or describe the nature of the decline in vitality that accompanied or was inherent in the radiation life shortening process. (auth)

24550 (USNRDL-TR–67-22) RELATIONSHIP OF EXPOSURE RATE AND EXPOSURE TIME TO RADIATION INJURY IN SHEEP. Page, Norbert P.; Ainsworth, E. John; Leong, George F. (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 10, 1967. 36p. CFSTI.

The relation of exposure-rate and exposure-time to injury accumulation and radiation lethality of sheep was studied using continuous cobalt-60 gamma exposure. Median lethal doses (LD_{50}'s) were determined at five rates, 660, 261, 30, 3.6, and 2.0 (R/hr). A decrease in dose-effectiveness, resulting in an increased LD_{50}, occurred as the exposure-rate was decreased (or when the exposure is protracted over a longer period of time). These data, relating LD_{50} to the exposure-rate, show linearity through the range of 660-30 R/hr, but the curve departs sharply from this relation between 30 and 3.6 R/hr. Studies of the kinetics of injury accumulation at 3.6 R/hr indicate that a decrease in the rate of injury accumulation occurs as the total exposure and time of exposure are increased. Departures from linearity which occur both in studies of injury accumulation and LD_{50} may indicate that at least two "recovery processes" are operative. The existence of two distinct mechanisms, "early" and "late" recovery processes, have been previously demonstrated with cell-culture systems. The results of the cell-culture studies and the present data appear to be related. Our data with sheep do not support the assumption made in several military and civil defense publications that the biological effect in man and livestock of an exposure received over a 96-hour period (termed "brief" exposure) is the same as that received in a few minutes. This report shows that in sheep protracting the exposure from a few minutes to 96 hours results in doubling the LD_{50}. (auth)

24551 (USNRDL-TR–67-26) FETAL LIVER CELLS: A SOURCE OF SPECIFIC IMMUNOGLOBULIN PRODUCTION IN RADIATION CHIMERAS. Tyan, Marvin L.; Cole, Leonard J.; Herzenberg, Leonard A. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 24, 1967. 17p. CFSTI.

Adult-thymectomized and intact $(C57L \times A)F_1$ mice were x irradiated (870 rad), and injected ip with 20 to 33×10^6 nucleated cells from livers of 14 to 21 day C57Bl/6 × C57Bl/6 embryos. In other experiments the mice received 0.3×10^6 syngeneic bone marrow cells (iv), and dissociated gut cells from 14 to 21 day C57Bl/6 × embryos (ip). The sera from these chimeras were assayed for the presence of donor-type γ-globulins. These mice were also sensitized to a synthetic polypeptide (TGAL), and their sera tested for total and for donor-type anti-TGAL antibody. All the mice, thymectomized as well as intact, which received fetal liver cells, had significant quantities of donor-type γ-globulins in their sera by 58 days postirradiation. Only 1 of 14 mice injected with embryonic gut cells was found to have donor-type γ-globulins by 95 days post-irradiation. Following immunization with TGAL, the fetal liver cell chimeras (intact thymus) exhibited specific antibody (10/10), while none of the thymectomized chimeras (0/21) were positive for this antibody. In the immunized, intact-thymus group, significant amounts of the specific anti-TGAL antibody were of donor origin. Thus, mouse fetal liver, as early as the 14th day of gestation, contains lymphoid stem cells capable of immunoglobulin synthesis in the absence of thymus. However, their ability to form certain specific antibodies is dependent upon intact thymic function. The results suggest that the donor-type immunoglobulins synthesized in the absence of the thymus may be defective antibody-like molecules. (auth)

24552 (USNRDL-TR–67-27) PROTECTION THROUGH PARABIOSIS AGAINST THE LETHAL EFFECTS OF LARGE X-RAY EXPOSURE DOSES. Carroll, H. W.; Kimeldorf, D. J. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 17, 1967. 17p.

Parabiotic rat pairs with a skin-vascular anastomosis were used to test whether shielding of one member of the pair would protect the irradiated partner against exposure to large doses of x rays (1200 to 2400 R). With the exception of the lowest dose, all unshielded, irradiated pairs or single irradiated animals died before 5 days had elapsed. In contrast, irradiated rats that had a shielded parabiont partner survived the 5-day period and many survived beyond 30 days. This is interpreted as protection against the acute intestinal death that normally occurs in the dose range investigated. (auth)

24553 (ANL-Trans–441) EFFECTS OF A SUBLETHAL X-RAY DOSE UPON CULTIVATED CHICKEN HEART MYOBLASTS. Schaefer, Dieter. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Z. Zellforsch. Mikroskop. Anat., 68: 320-47(1965). 34p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $3.60 fs, $1.25 mf.

Chicken embryo heart myoblasts in tissue culture stop the mitotic division immediately after x irradiation with 1200 R. After about 20 hours the mitotic rate is normal again. Electron microscopic observation of the nucleoli showed that the protein synthesis is temporarily disturbed by radiation, for during the first hours after irradiation the nucleoli are in a close contact with the nucleus membrane to a very high amount. Later this contact is only relatively rare. In the phase of restitution, however, this appearance is observed to be increased to a maximum. It is reduced to a normal level towards the end of the reversible damage period. (C.H.)

24554 ATROPHY OF GENITAL ORGANS OF YOUNG AND ADULT MICE IRRADIATED WITH 14.1 MeV FAST NEUTRONS AND 180 kVp X-RAYS. Yamamoto, Samu (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1237-41(Dec. 1966). (In Japanese).

Genital organ atrophy in young and adult mice irradiated with 14.1 MeV fast neutrons and 180 kVp x rays was studied. Testicles in both adult and young mice showed remarkable atrophy. Seminal vesicle atrophy in adult male mice, and ovarian and uterine atrophy in adult female mice were not so marked, while these organs of young mice were very sensitive to radiation. The greater weight differences among genital organs as a function of radiation dose in young mice should be referred to as "growth suppression" rather then "atrophy." RBE values obtained for fast neutron x rays are as follows: for adult male mice, body weight loss 1.81, and testicular atrophy 2.76 (1/2 weight) and 1.65 (1/e weight); for adult female mice, body weight loss 2.13; for young male mice, body weight loss or growth suppression 1.68, testicular atrophy or growth suppression 2.70 (1/2 weight) and 2.27 (1/e weight), and seminal vesicle atrophy or growth suppression 1.93 (1/2 weight) and 1.91 (1/e weight); and for young female mice, body weight loss or growth suppression 1.92, ovarian atrophy or growth suppression 3.19 (1/2 weight) and 2.28 (1/e weight), and uterine atrophy or growth suppression 1.74 (1/2 weight) and 1.54 (1/e weight). (NSA of Japan)

24555 TRANSIENT CHANGES IN THE RADIOSENSITIVITY OF MAMMALIAN CELLS ON TRANSFER FROM IN VIVO TO IN VITRO CULTURE CONDITIONS. Cullen, B. (Hammersmith Hospital, London). Nature, 213: 1268-70(Mar. 25, 1967).

Conditions of culture play an important part in determining the radiation response of micro-organisms. Mammalian cells grown in vitro only remain viable within a rather limited range of culture conditions. Some studies are reported using cells of the Ehrlich diploid mouse ascites tumor grown in vitro for 3 years. It was found that the radiobiological response was profoundly affected if cells previously grown in vitro were allowed to grow in vivo for some generations and then transferred to in vitro conditions before irradiation. The effect was transient and disappeared within the period of the first in vitro cell division. (UK)

24556 NEUROSECRETING REACTION OF THE HYPOTHALAMUS AFTER VARIOUS TYPES OF EXPOSURE TO X RADIATION. Hajdukovic, S.; Duchesne, P. Y. (Univ., Liege). Compt. Rend. Soc. Biol., 160: 1971-2(1966). (In French).

The hypothalamic-hypophysic reaction under the stress of irradiation, described previously in the rat after exposure to a dose of 800 R, was also shown after weaker doses administered at an output of 100 R/min; the threshold dose seemed to be 200 R. The output can be reduced to 10 R/min. The isolated irradiation of the body or of the head provoked the same type of reaction. (tr-auth)

24557 FUNCTIONAL CHANGES OF THE THYROID GLAND UNDER THE EFFECT OF MICROWAVE IRRADIATION. Fofanov, P. N. Probl. Endokrinol. Gormonoterap., 12: No. 5, 16-17 (Sept.-Oct. 1966). (In Russian).

Persons subjected to superhigh frequency irradiation for a prolonged period of time exhibited intensified function of the thyroid gland, the most pronounced 2 to 4 hours after ^{131}I administration. Possibly vegetative changes, not infrequently occurring in these persons, reflected to some extent the increased thyroid gland function. Changes in the thyroid gland activity were evidently a part of the complex of general adaptive reactions in response to superhigh frequency irradiation. (auth)

24558 CYTOLOGICAL STUDIES OF ORGANOTYPIC CULTURES OF RAT DORSAL ROOT GANGLIA FOLLOWING X-IRRADIATION IN VITRO. II. CHANGES IN SCHWANN CELLS, MYELIN SHEATHS, AND NERVE FIBERS. Masurovsky, Edmund B.; Bunge, Mary Bartlett; Bunge, Richard P. (Columbia Univ., New York). J. Cell Biol., 32: 495-518(Feb. 1967).

Cultured rat dorsal root ganglia were irradiated with a 40-kR dose of x rays and, after observation in the living state, were fixed for light and electron microscopy. Within 24 hr after irradiation, Schwann cells investing unmyelinated axons acutely degenerated. The axons thus denuded displayed little change. Conversely, few ultrastructural changes developed in Schwann cells investing myelinated axons until after the 4th day. During the 4- to 14-day period, these Schwann cells and their related myelin sheaths underwent progressive deterioration. Associated axons decreased in dia but were usually maintained. Myelin deterioration began as a nodal lengthening and then progressed along 2 different routes. In intact Schwann cells, fragmentation of myelin began in a pattern like Wallerian degeneration, but its slow breakdown thereafter suggested metabolic disturbances in these Schwann cells. The second pattern of myelin deterioration, occurring after complete degeneration of the related Schwann cell, involved unusual configurational changes in the myelin lamellae. Atypical repeating periods were formed by systemic splitting of lamellae. These observations provided the first description of ultrastructural changes produced by ionizing radiation in nerve fascicles in vitro. (BBB)

24559 SOME PHYSIOLOGICAL EFFECTS OF AIR ION TREATMENT WITHOUT ION INHALATION. McDonald, R. D.; Bachman, C. H.; Lorenz, P. J. (Syracuse Univ., N. Y.). Int. J. Biometeorol., 9: 141-7(Oct. 1965).

The effect on rats of ions produced in air by ^{85}Kr β radiation was examined. For average ion densities of 500,000 ions/cm^3, heart and respiratory rates were stimulated by either positive or negative air ion inhalation. To examine the possible role of internal electric currents arising via conduction from an exposed body surface area, and experiment was carried out without inhalation of ionized air. The purpose was to determine if any of the heart or respiratory effects might be induced independently of the respiratory system. The bridge of the animal's nose was exposed to ions but inhalation of the ionized atmosphere was prevented. The heart rate was unaffected by negative air ion exposure, but positive air ions caused depressed heart rate. Respiration rate was generally unaffected by ions although there was a possible final difference under negative air ion treatment. The only significant effect observed from superficial exposure alone was a depression in heartbeat under positive ion treatment. This contradictory result may indicate more than a single mechanism for the action of air ions on heartbeat frequency, with the depressive effect being overridden in the first experiment. Possibly, heartbeat stimulation was a secondary effect resulting from stimulation in respiration by positive ion inhalation. It is concluded that investigations of the biological effects of air ions should be reported with a detailed description of the nature of the ion exposure or administration as well as of information regarding dose values. (BBB)

24560 DI GUGLIELMO'S SYNDROME AFTER POLYCYTHEMIA. Bank, Arthur; Larsen, P. Reed; Anderson, H. M. (Columbia Univ. Coll. of Physicians and Surgeons, New York). New Engl. J. Med., 275: 489-90(Sept. 1, 1966).

The possible induction of erythroleukemia by ^{32}P in a patient treated with the radioisotope for polycythemia vera is reported. Recently, two other cases of acute erythroleukemia (Di Guglielmo's syndrome) developing in patients with polycythemia vera were reported. In the 61-yr-old man with polycythemia described, treatment was begun with phlebotomies and radiophosphorus in three doses given by mouth (9.05, 7.0, and 8.94 mCi at intervals of ~6 months. The patient's condition remained unchanged until 4 yr after the last dose, when he was found to be pancytopenic for the 1st time, with 60% lymphocytes in the peripheral blood. Bone-marrow examination revealed a cellular marrow with erythroid hyperplasia and 12% megaloblast like cells and many bizarre proerythroblasts and normoblasts containing nuclear fragments and double nuclei. Despite antibiotics and high-dose steroid therapy, he died 6 months later. A recent statistical analysis of cases of polycythemia vera treated with ^{32}P revealed a much higher incidence of acute leukemia when this group was compared to untreated patients of the same age and duration of disease. The peak incidence of leukemia after 20 to 29 mCi of ^{32}P therapy is at 4 to 5 yr. A suitable latent interval of 5 yr was noted in the case presented, whereas it was 3 yr in another case of erythroleukemia that followed ^{32}P therapy for polycythemia vera. The relation between ^{32}P therapy and the subsequent development of leukemia could be explained if the stem cells in polycythemia vera were more susceptible than normal stem cells to malignant change. (BBB)

24561 BIOLOGICAL EFFECTS OF OXYGEN. Gerschman, Rebeca (Univ., Buenos Aires). pp 475-94 of Symposium on Oxygen in the Animal Organism. Dickens, F.; Neil, E. (eds.). London, Pergamon Press, 1964.

The interaction between oxygen and ionizing radiation in influencing tissue radiosensitivity is considered along with other effects of oxygen. It is postulated that the basic mechanism of oxygen poisoning is similar to the initial biological effects of x irradiation. In the primary process of ionizing radiation on water an electron is removed from the water molecule. Both the positively charged water molecules and the electrons can become hydrated rapidly to form the free radicals H and OH. The reduction of oxygen by hydrogen would lead to the formation of the free radicals HO_2 and OH and H_2O_2. The formation of free radicals by irradiation would increase chain centers and thus promote the reaction in attaining equilibrium is oxidation, then the effect of the radiation will be an oxidizing one, but if the net reaction in attaining equilibrium is reduction, then the effect of the radiation will be a reducing one. Irradiation may merely accelerate the toxic effects of oxygen in some biological systems. Some of the similarities between x irradiation and oxygen poisoning are summarized. Above a certain oxygen tension, chain reactions may become significant and the toxic effects of oxygen suddenly become more apparent. This critical oxygen tension for mice lies between 0.7 and 1 atm in the inspired air, as judged by the abrupt decrease in their survival time. A critical dose of x rays also results in a sudden decrease in the survival time of mice. The nematode Caenorhabditis withstands extraordinarily high amounts of irradiation. For comparison the author tested them with oxygen, showing them to be the most resistant of organisms yet studied. They appeared unaffected after 1 hr at 135 atm of oxygen, but showed no signs of mobility after 24 hr at this high pressure. The concept of a similarity between irradiation and oxygen effects has led to the use of a variety of chemical agents which have proved capable of modifying oxygen toxicity. (BBB)

24562 THE PRESENT STATUS OF CLINICAL RENAL HOMOTRANSPLANTATION. Hallenbeck, George A.; Shorter, Roy G. (Mayo Clinic, Rochester, Minn.). Med. Clin. N. Amer., 50: 1165-73(July 1966).

The present status of the use of ionizing radiation and other antimitotic agents to ameliorate the host-vs-graft reaction in kidney transplantation is reviewed. General suppression of immune responses may be accomplished to some degree by irradiation of the

recipient, by use of certain drugs, or by a combination of the two. Although whole-body irradiation can eradicate the immune response, the doses necessary also produce such depression of bone marrow and damage to the intestinal mucosa that death often results. Since it has proved almost impossible to find a dose of radiation which is large enough to permit survival of renal allografts and yet small enough to permit survival of the patients, this method of immunosuppression is not now used by most investigators. However, it has been reported that the survival of dogs with renal allografts as their sole kidneys is prolonged by repeated local x irradiation to the region of the kidney as the only treatment. Currently local irradiation of renal grafts in patients is being done routinely in some centers during the first week after transplantation, but in others it is reserved for treatment of rejection that has become apparent clinically. Its mode of action is poorly understood. Various immunosuppressive drugs may be used with or without radiation. (TSS)

24563 IMMUNITY TO HAEMONCHUS CONTORTUS INFECTION: RELATIONSHIP BETWEEN AGE AND SUCCESSFUL VACCINATION WITH IRRADIATED LARVAE. Urquhart, G. M.; Jarrett, W. F. H.; Jennings, F. W.; McIntyre, W. I. M.; Mulligan, W. (Univ. of Glasgow). Amer. J. Vet. Res., 27: 1645-8(Nov. 1966).

Attempts were made to determine the cause of failure to vaccinate successfully young lambs against experimental infection with a system which conferred marked protection on sheep of 8 months and over. The irradiation of the larvae was performed with an x-ray machine that delivered the radiation dose at a rate of 750 R/min. The advantage of the increased output of the new machine was that the time required for irradiation was greatly reduced. To determine whether larvae irradiated at this higher dose-rate were as equally attenuated and as immunogenic as those used formerly in the vaccinal preparation, preliminary experiments were conducted with 17-month-old sheep vaccinated two times (1-month interval between doses) with 10,000 Haemonchus contortus larvae irradiated at 40 kR. Some were given larvae treated at 750 R/min, and others received larvae treated at 200 R/min. Thirty days after the vaccination the sheep were given a challenge dose of 10,000 normal larvae. The numbers of worms found at necropsy 30 days later indicated that the irradiation rate did not affect the immunogenicity of the larvae. Vaccination with 2 doses of 10,000 40-kR-x-irradiated larvae, given at an interval of 28 days, did not confer protection against a challenge inoculation of 10,000 larvae given 30 days after the 2nd vaccine. The lambs were initially vaccinated at 5 weeks of age. Variations in the technique of immunization, such as the use of Freund adjuvant alone or combined with Fasciola antigen, intraperitoneal injections of normal Haemonchus larvae, reduction in the number of irradiated larvae used for a vaccination dose, or substitution of a serial daily challenge exposure for a single challenge dose were of no value in stimulating the development of resistance. (BBB)

24564 POLYMORPHOUS LIGHT ERUPTIONS: WAVELENGTH DEPENDENCY AND ENERGY STUDIES. Epstein, John H. (Univ. of California, San Francisco). Arch. Dermatol., 85: 82-8(Jan. 1962).

The induction of skin lesions by uv radiation was studied in 29 human subjects, with emphasis on the action spectra and energies required. Positive phototests were produced by uv radiation shorter than 3200 Å in all 29 patients with polymorphous light eruptions. No abnormal reactions occurred to longer wavelengths, indicating that the action spectrum for these patients was in the sunburn range (2900 to 3200 Å). The amount of energy required to produce the positive tests varied from 0.42×10^6 to 58.20×10^6 erg/cm^2. In general, less energy was needed to produce positive phototests and minimal erythema responses in the eczematous and small papular forms than in the prurigo and erythema multiforme types. The energy requirements varied greatly within each clinical group thus making differentiation on the basis of levels of sensitivity impossible. In most cases a brisk phototoxic response was needed to produce positive tests. Of the 16 patients tested with the cold quartz source, 15 showed positive phototests. Control tests with Corex D filtration indicated that these reactions were caused by phototoxic rays not present in the natural sunlight spectrum that reaches the earth's surface. (BBB)

24565 MODIFICATIONS OF THE AGE-DEPENDENT CYTOGENETIC RADIOSENSITIVITY OF MAMMALIAN SOMATIC CELLS. Konoplyannikova, O. A. (Inst. of Biological Physics, Moscow). Genetika, No. 10, 111-19(Oct. 1966). (In Russian).

Cytogenetic radiosensitivity of bone marrow cells of mice and monkeys of different ages and the efficiency of 5-methoxytryptamine in reducing the radiation damage were investigated. Marrow cells were the most radiosensitive in mice at the ages of 10 days and 12 months and in monkeys at the age of 8 to 10 years. The lowest radiosensitivity was observed in mice at the age of three months and in monkeys at the age of 3 to 4 years. Protective effects of 5-methoxytryptamine injected prior to irradiation were independent of age, the same pattern of cytogenetic radiosensitivity being observed as in controls. (auth)

24566 ADULT LIFE SPAN IN HABROBRACON SERINOPAE AFTER X-IRRADIATION DURING EARLY DEVELOPMENT. Clark, A. M.; Osmun, D. E. (Univ. of Delaware, Newark). Nature, 214: 717-18(May 13, 1967).

It was found that the adult wasps showed a decrease in life span with exposure to increasing doses of ionizing radiation; also that diploid males were more resistant than haploid males. A similar pattern occurred after irradiation at larval and pupal stages. Studies are described with a view to ascertaining whether this pattern holds for all stages of development. The adult life span of ploidy types after x-irradiation of early embryos during the cleavage stage was determined. During the adult stage in holometabolous insects somatic cell division is absent, whereas during the cleavage stage nuclei are rapidly dividing. These differences allowed comparison of the radiation sensitivity of a stage in which there is active nuclear mitosis with that in which there is no somatic cell mitosis. Diploids were here found to be more radiation sensitive than haploids. There was no consistent decrease in adult life span with increasing dose. Irradiation injury was manifested at cleavage or not at all. The radiation sensitivity during cleavage probably results from arrestment of mitosis, in contrast to post-embryonic and adult stages, where an upset in genic balance relations or loss of gene function may obtain. It is stated that, although in mammals embryonic stages are known to be more sensitive to ionizing radiation than post-natal stages it is possible that there is no decrease in adult life span amongst survivors from irradiated early embryos. (UK)

24567 ACCUMULATION OF CHROMOSOME DAMAGE UNDER CONTINUOUS LOW DOSE RATE EXPOSURE. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore). Radiology, 88: 767-74(Apr. 1967).

The frequency of chromosome aberrations in proliferating parenchymal cells in the regenerating liver of the August rat after continuous whole-body gamma irradiation at dose rates of from 16 to 375 RADS/day was dependent on the dose rate, the duration of exposure, and the accumulated dose. There was a considerable dose rate effect; initial repair presumably occurred through immediate restitution and became less effective with increasing dose rate. At 16 and 47 RADS/day, with increased duration of exposure, the aberration frequency remained constant with time. The system deteriorated after approximately sixty days and much sooner after dose rates of 70 RADS/day or more. At 375 RADS/day for more than one day, a steady state condition could not be established. Long-term repair may have been effected by means of intracellular mechanisms for restitution of chromosome injuries or by the selection against damaged cells at the time of mitosis. (auth)

24568 HISTOCHEMICAL AND ULTRASTRUCTURAL MODIFICATIONS INDUCED BY IONIZING RADIATIONS ON THE MESENTERON OF DACUS OLEAE GMEL. Baccetti, B.; de Dominicis, Raffaella; Cappellini, Mario (Univ., Siena, Italy). Redia, 46: 205-22(Nov. 25, 1961). (In Italian).

Electron microscopic studies were conducted on the mesenteron of Dacus oleae irradiated in the pupal stage. Pupae were exposed to 12, 20, 30, 32.5, 40, and 50 kR doses of 200-kV x rays and the mesenteron of the adults was examined 4 to 7 days later. Ultrastructural changes were first noted with the 30 kR dose. Higher doses produced cellular injury that was not proportional in the three types of cells in the mesenteron. The injury caused by irradiation was seen as a displacement and eventual disappearance of the microvilli, which was accompanied by a secretion evident macroscopically; fragmentation of the nuclei, and appearance of vacuoles in the ergastoplasm and Golgi apparatus. Histoenzymatic studies showed a decrease in succinic dehydrogenase and cytochrome oxidase activity in the same tissue. Marked changes in enzyme activity were noted only at the highest doses. (BBB)

24569 STUDIES OF THE RADIOSENSITIVITY OF THE HARDING–PASSEY MELANOMA OF THE MOUSE. Flatow, Hans-Henning; Rohde, Bernward (Univ., Hamburg). Arch. Klin. Exp. Dermatol., 226: 355-8(1966). (In German).

Mice injected with Harding–Passey melanoma cells were x-irradiated with 5000 to 22,500 R at a dose rate of 1000 R/day administered at 3320 R/min. Alopecia and hyperemia were observed at 10,000 R and above. At 15,000 R necroses were observed. During the irradiation period 20 to 30% of the animals died. The study was evaluated starting 3 weeks after tumor transplantation and ended 4 months later. The number of tumors that developed decreased as the amount of irradiation increased. With no irradiation ~40% of the tumors increased beyond the original size when implanted. Few or none developed in the animals that

received 17,500 R or more. The numbers of tumors that developed varied widely from group to group. An irradiation dose between 5000 and 10,000 R reduced transplant growth by more than 20%. Even at 22,500 R, though, a few tumors still developed. Portions of the tumors located beneath the surface were relatively less damaged by irradiation. This was confirmed by removal and examination of the tumor growths. The Harding–Passey melanoma seemed to be relatively insensitive to irradiation. Its destruction was due to injury of the radiosensitive vascular endothelia, and the impairment of nutritional supply to the tumor that resulted from this. (BBB)

24570 RELATIVE ENERGY REQUIREMENTS FOR AN ERYTHEMAL RESPONSE OF SKIN TO MONOCHROMATIC WAVELENGTHS OF ULTRAVIOLET PRESENT IN THE SOLAR SPECTRUM. Freeman, Robert G.; Owens, Donald W.; Knox, John M.; Hudson, H. T. (Baylor Univ., Houston, Tex.). J. Invest. Dermatol., 47: 586-92(1966).

A high intensity grating monochromator was used to determine erythema-producing effectiveness of uv radiation on untanned human abdominal skin and albino rabbit skin. Greatest efficiency was observed at 250 to 260 mμ with a second peak at 292 mμ, a slight drop at 280 mμ, and a rapid decrease at 240 and at 310 mμ. A product curve was derived by multiplying the reciprocal of erythema energy values by the values for solar radiation under specific atmospheric conditions. This curve demonstrated that maximum solar erythema production occurs at 305 to 308 mμ and that longer wavelengths, though inefficient, account for a significant proportion of solar erythema because of the great amount of energy in sunlight at these wavelengths. Wavelengths shorter than 294 mμ do not contribute to solar erythema. It was observed that as the air mass (m) increases, as it does in northern latitudes and in the early morning and late afternoon, longer wavelengths assume a proportionately greater role in solar erythema production. When m = 1, wavelengths longer than 314 mμ account for only 10% of the erythema effect. Conversely, when m = 3, wavelengths longer than 314 mμ account for 34% of the erythema production while those between 304 and 310 mμ account for 66%, and none below 304 mμ. Results of calculations using this formula for minimal erythema time determined from experiments using natural sunlight. (BBB)

24571 EPIDEMIOLOGICAL STUDIES OF PERSONS WORKING IN CONNECTION WITH NUCLEAR SCIENCE. Bruner, H. D. (Atomic Energy Commission, Washington, D. C.). Ind. Med. Surg., 36: 139-44(Feb. 1967).

Four general sources of data on irradiated humans which together may provide information and statistics on the chronic, long-term, or delayed effects of whole-body irradiation in man are examined. These include ~50 persons recovered from acute accidental exposures, survivors of the atomic weapon bursts over Nagasaki and Hiroshima, patients receiving whole-body irradiation for therapy, and employees in nuclear energy plants and laboratories exposed in the course of their work. Data for the last group are examined particularly. The health and radiological records on these workers extend over 23 yr and to an estimated 5 million man-yr of risk, enough for an epidemiological study of the possible long-term reactions of man to exposures chiefly in the range of zero to 30 times background. A planned large-scale retrospective-prospective study of the relations, if any, between employment in the nuclear energy industry and changes in health status is discussed. A major problem is the designation and development of control populations. Use of karyotypic analysis to detect previous irradiation is described and illustrated. (BBB)

24572 CUTANEOUS ZONES OF THROMBOHEMORRHAGIC REACTIVITY TO NORADRENALINE. Selye, H.; Tuchweber, B. (Univ., Montreal). Acta Anat., 63: 1-7(1966).

Following intravenous pretreatment with Thorotrast (ThO_2) plus tannic acid, which induced a thrombohemorrhagic diathesis in the rat, topical administration of noradrenaline produced local tissue changes similar to those of the Sanarelli–Shwartzman reaction, but only in certain cutaneous zones. The distribution of these zones was roughly charted and found to be essentially independent of the type of agent used to elicit the thrombohemorrhagic diathesis, Na caseinate + tannic acid or $FeCl_3$ + $CeCl_3$ being as effective as ThO_2 + tannic acid as sensitizers. Subcutaneous injection of noradrenaline produced local thrombohemorrhagic reactions of different intensity depending upon the site of its administration. This difference was demonstrated in 2 ways: (1) by injecting 2 doses of noradrenaline into the same rat at different sites after pretreatment with a given combination of sensitizer and (2) by giving single doses of the catecholamine at different points to animals prepared by diverse sensitizing procedures. The histologic structure of the subcutaneous tissue in the zones of different thrombohemorrhagic reactivity was essentially identical. (BBB)

24573 PATHOLOGICAL AND RADIOLOGICAL STUDIES OF CHRONIC THOROTRAST INJURY. PART I. STUDY OF HUMAN MATERIALS. Mori, Takesaburo (Yokohama City Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1028-88(Nov. 25, 1966). (In Japanese).

A review of the literature (266 references) of ThO_2-induced injury is presented along with biopsy and autopsy data for 16 cases which had received Thorotrast 18 to 27 yr previously. These cases included hemangioendothelioma and cholangiocarcinoma of liver, sarcoma of bone, adenocarcinoma of the breast, osteomyelofibrosis, and Thorotrast granuloma at the injected site. To investigate the relation between the amount of ThO_2 deposited and the resultant tissue damage, the livers were classified into 3 groups, as markedly, moderately, and slightly fibrotic. The radiation doses of these groups were calculated. In the markedly fibrotic group, the total tissue dose was between 1550 and 2500 rad, when measured as distributed diffusely throughout the whole organs. However, the Thorotrast granules exhibited irregular distribution. In some areas, the calculated irradiation dose ranged from 19,500 to 33,000 rad. The spleen of all cases showed structural destruction and fibrosis, as in the liver. In spleens classified into 3 groups. the average tissue dosage was 4000 to 5800 rad in the markedly fibrotic group, 5200 rad in the moderately fibrotic group, and 1050 rad in the slightly fibrotic group. The total tissue dose in severely fibrotic lymph nodes ranged between 4860 and 16,220 rad, that of moderately fibrotic ones 690 to 870 rad, and slightly fibrotic ones 274 to 346 rad. In the lymphoid tissues of the esophagus and tonsil there were scattered deposits of ThO_2 granules. In the bone marrow myelofibrosis occurred in parallel with the amount of Thorotrast deposited. Thorotrast deposition was also demonstrated in the heart, lung, kidney, pancreas, adrenal, testis, and uterus, but the tissue damage of these organs was slight. Thus, the basic tissue damage from Thorotrast deposition was produced by the destruction and regeneration of the parenchymal cells of the target organs, reticuloendotheliosis, and local circulatory disturbances due to destruction of the blood and lymph vessels, finally resulting in extensive fibrosis. (BBB)

24574 FOLLOW-UP STUDY OF THE FATE OF PATIENTS WHO HAD BEEN ADMINISTERED THOROTRAST MORE THAN 22 YEARS PREVIOUSLY. Mori, Takesaburo; Nozue, Yushin; Okamoto, Takashi; Tanaka, Toshihiko; Sugita, Kido; Tsuda, Tadayoshi (Yokohama City Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 25: 1144-65(Jan. 25, 1966). (In Japanese).

To ascertain the late effects of Thorotrast in humans, a large-scale follow-up investigation was conducted in soldiers who had been injected with Thorotrast, as an x-ray contrast medium, between 1937 and 1943 in the examination of the injuries received during the Second World War. For this, 147 males who had been administered Thorotrast were studied from the protocols of army hospitals in Japan. As controls, 160 males who had been given iodinated contrast medium (control group A), and 1679 males who had never received a contrast medium (control group B) were selected from protocols of the same hospitals. The doses of Thorotrast used varied from 3 to 75 ml. It was mainly used for angiography but sometimes for hepatolieno-, broncho-, and pyelography. Among the Thorotrast group, information from 139 cases was available regarding their present health (94.6%); of these 112 were living and 27 had died. The latter included 3 cases of liver cancer, 1 of leukemia, and 2 of liver cirrhosis. In the control group A, data on 135 cases out of 160 (84.4%) revealed 113 were living and 22 were dead. None of the deceased cases had either malignant tumor or liver cirrhosis. In the control group B, out of 1679 cases information was available for 1426 (84.9%); of these 1209 were living and 217 were dead. Among the deceased were 14 cases of malignant tumor, 1 of leukemia, and 5 of liver cirrhosis, but no cases of liver tumor. Between this control group and the general population there was no statistically significant difference in the occurrence of liver cirrhosis. By the χ^2-test the Thorotrast group revealed a higher mortality due to liver cancer and liver cirrhosis than the same age group of the Japanese male population, the level of risk being 0.5% and 5%, respectively. Thus, the occurrence of liver carcinoma and liver cirrhosis among men who had received Thorotrast was significantly higher than among the general Japanese male population. (BBB)

24575 CLONE FORMATION IN TISSUE CULTURE: EXPERIENCE FROM LONG-TERM CULTURES OF IRRADIATED HUMAN SKIN. Visfeldt, Jakob (Radium Centre, Copenhagen). Acta Pathol. Microbiol. Scand., 68: 305-12(1966).

To investigate radiation-induced chromosome aberrations in human cells, human skin exposed to radiation in vivo was studied after prolonged periods of tissue culture. Chromosome analyses were then carried out upon cells taken from subcultures. Whether or not a quantitative relation exists between the dose of radiation

and chromosome aberrations after in vivo irradiation of human skin was determined. The skin biopsies were taken 3 to 72 hr after 100- or 500-R doses of 100-kV x rays applied to the forearm. All the control cultures and those derived from skin which had received 100 R produced satisfactory growth, but the cultures from skin exposed to 500 R did not. Types of aberrations observed could be divided into three groups: abnormalities of chromosome numbers, structural chromosome aberrations, and chromatid aberrations. About 10% aneuploid cells were found, predominantly hypodiploids. No statistically significant difference was found between cells from irradiated and nonirradiated skin. Most structural chromosome aberrations were translocations, pericentric inversions, and abnormal distribution between the subgroups, into which the chromosomes are divided. Only a single cell with a translocation was found among the controls. Only a few chromatid deletions or single fragments were found. There were, however, many fractures and achromatic lesions, but the statistical difference between the irradiated and nonirradiated biopsies was insignificant. Significant differences between irradiated and nonirradiated skin were only found among the stable aberrations. Among the 955 analyzed cells derived from skin irradiated with 100 R, 79 cells contained aberrations. These included translocations, pericentric inversions, and abnormal distributions among the subgroups following translocation. In the 447 analyzed cells from the controls, only 1 contained a stable aberration. The variation in the number of cells containing translocations in the cultures from irradiated skin was considerable, between 3 and 14% of cells analyzed from the different cultures. The radiation-damaged cells which contained abnormal chromosomes, and which could grow in the cultures carried definite, stable aberrations which formed balanced karyotypes. (BBB)

24576 CHANGES OF FREE FATTY ACIDS IN THE AMNIOTIC FLUID AND FETAL AND MATERNAL BLOOD PLASMA OF RATS FOLLOWING WHOLE-BODY IRRADIATION WITH 800 R. Winkler, L. (Friedrich-Schiller-Univ., Jena, Ger.). Acta Biol. Med. Ger., 17: 186-92(1966). (In German).

After ionizing irradiation a significant increase in plasma free fatty acids has been reported in pregnant rats. Changes in free fatty acids in the fetus were examined after pregnant Wistar rats were exposed to 800 R on the 19th day of gestation. Twenty-four hr after irradiation the concentration of free fatty acids in fetal plasma and in amniotic fluid was twice normal, while no significant increase of concentration could be found in the maternal plasma. In contrast to changes of the absolute concentration in the fetal plasma and amniotic fluid, no significant difference from the pattern of sham-irradiated control animals was noted in the composition of free fatty acid fractions. In the maternal plasma the proportion of linoleic acid in free fatty acids was increased by 30% after irradiation. The findings are discussed with respect to the genesis of the fatty infiltration of the fetal liver following irradiation. (BBB)

24577 POSTPUBERTAL OOGENESIS FOLLOWING ^{60}Co IRRADIATION IN THE ALBINO RAT. Rochowiak, Michael W. (Creighton Univ., Omaha). Obstet. Gynecol., 29: 173-80(Feb. 1967).

In 3-month-old rats 300-R irradiation of the whole body and of the ovarian region only produced similar results: a two-thirds reduction in primordial follicles with a concomitant doubling of the number of mature follicles. A shift to the more mature follicular type was observed, presumably due to an increased utilization of gonadotropin by the remaining primordial follicles. Species differences should always be considered in the interpretation of these results as shown by a comparison of these data with those obtained in mice. Once established, the shift to a preponderance of mature follicles in the rat remained constant. Oogenesis must have occurred at a rate sufficient to maintain this proportion. That the germinal epithelium was responsible for oogenesis in the adult irradiated rat was shown by light and electron micrographs. Irradiation to the head region only was ineffective, suggesting that the hypothalamus and pituitary play a passive role in the production of superovulation. (BBB)

24578 MICROWAVE RADIATION OF 10 mw/cm^2 AND FACTORS THAT INFLUENCE BIOLOGICAL EFFECTS AT VARIOUS POWER DENSITIES. Deichmann, William B.; Stephens, Frank H. Jr. (Univ. of Miami, Fla.). Ind. Med. Surg., 30: 221-8 (June 1961).

It is suggested that the recommended human tolerance dose of 0.1 w/cm^2 of absorbed microwave radiation is too high, and experimental data are cited that indicate that this dose should be lowered to 0.01 w/cm^2. Experimental microwave studies have demonstrated that many factors must be closely controlled to obtain reproducible dose-effect results with animals. These factors, which modify significantly what may be considered a safe exposure level, include: the frequency or wavelength of the generating equipment, time of exposure, irradiation cycle rate (ON-OFF periods during a unit time interval when total time of irradiation is kept constant), air currents, environmental temperature, body weight, covering in relation to the exposed area, orientation or position of an individual influencing resonant conditions and standing waves, differences in sensitivity of organs and tissues, and effect of reflections. (BBB)

24579 PATHOLOGICAL AND RADIOLOGICAL STUDIES OF CHRONIC THOROTRAST INJURY. PART II. EXPERIMENTAL STUDY. Mori, Takesaburo (Yokohama City Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1089-1129(Nov. 25, 1966). (In Japanese).

Experimental studies were designed to clarify the morphogenesis of the structural damage produced by Thorotrast. For analysis of the Thorotrast injury, 3 etiologic features should be considered: its radioactivity, its action as a foreign body, and its toxicity. As control agents, India ink, carmine (both acting as a foreign body), and trypan blue (a dye which is chemically toxic) were used. Thorotrast was introduced into mice, rats, and rabbits by vein. The amount of Thorotrast, once deposited in the tissue, showed no apparent decrease throughout 16 months. On the other hand, the control agents deposited within tissues diminished rapidly in quantity between 6 to 12 months. To compare the effect of different Thorotrast doses, 1.25, 5, and 25 ml of Thorotrast per Kg of body weight was administered to different groups. A good correlation was noted between the dose and histologic changes, which consisted of progressive destruction of cells followed by regeneration, reactive reticuloendotheliosis, destruction of the peripheral blood and lymph vessels, and secondary proliferation of the connective tissue resulting ultimately in extensive fibrosis. In distinction to the Thorotrast group, India ink and carmine caused only slight and temporary histologic changes. Trypan blue caused diffuse retrograde cellular damage of the parenchymal tissues, increasing in severity according to the doses given, but it was not progressive. Histochemical procedures indicated that aggregates of Thorotrast particles contained sugar and protein as an adhesive substance, which probably aids in the phagocytosis of the particle by the reticuloendothelial cells. The tissue radiation dose from Thorotrast in the experiments was 6.7 to 79.3 rad/week in liver and 10.3 to 177.7 rad/week in spleen. Thus, its radioactivity and action as a foreign body act together in the morphogenesis of the chronic Thorotrast injury, while its chemical toxity is insignificant. Localized circulatory disturbances resulting from vascular damage probably play a major role in intensifying the tissue destruction and fibrosis caused by Thorotrast. (BBB)

24580 ON PATHOLOGY DUE TO IONIZING RADIATIONS. HEMATOLOGIC CHANGES. I. Coppola, A. (Univ., Palermo, Italy). Folia Med., (Naples), 49: 253-60(Apr. 19, 1966). (In Italian).

Hematologic and bone marrow changes were followed in guinea pigs exposed to low chronic doses of whole-body radiation. A single dose of 5 R was given once a month for 4 months. The peripheral red cell count fell slightly beginning the 90th day after the first dose of radiation, and reached a level only 3% below normal by the 120th day. The most marked drop occurred in platelets, and was progressive over the 120-day period, reaching a final level of ~85% of normal. Eosinophils showed a marked rise, to 150% of normal by the 120th day. At this time the following levels were reached by other cell types (as % of normal): reticulocytes 92.5%, neutrophils 85%, and lymphocytes 96%. Bone marrow cell counts revealed an increase in histiocytes and eosinophils, whereas megakaryocytes fell. The lymphoid/erythroid ratio in bone marrow fell from 1.4 to 1.1. (BBB)

24581 ON ECG CHANGES AFTER WHOLE-BODY IRRADIATION AND LOCAL IRRADIATION OF THE HEART OR OF THE HEAD. Vokrouhlicky, Lubor; Jurkovic, Vilo (Charles Univ., Hradec Kralove, Czech.). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 9: 737-42(1966).

Serial electrocardiography recordings were made in rabbits after whole-body x irradiation and local irradiation of the heart or head, with 1000 R. Despite marked signs of radiation disease there were no abnormal changes in the EKG during the 13 days after whole-body irradiation with the exception of QRS axis deviation and concomitantly of the T wave. There were no EKG abnormalities even in animals one day before death. There were only minor abnormalities of short duration, e.g., single ventricular extrasystoles in 13% immediately after irradiation. They disappeared the next day. Cardiac frequency increased from the 6th day after irradiation and tachycardia was constant until the 13th day. ST wave depressions were never more than 0.1 mV, mostly shortly after irradiation. ST changes were marked in the thoracic lead. Changes of the electrical axis were more frequent than in nonirradiated animals; axis deviations were found in 73% of cases (QRS and secondary T changes). During

the 13 days after local irradiation of the heart there were no EKG abnormalities, with the exception of electrical axis deviation associated with changes of QRS and T. In the summation thoracic lead there was a decrease of the T wave 6 to 7 days after irradiation, with terminal negativity of the T wave. Marked negativity of the T wave never occurred. Primary T changes without changes of the original QRS complex were never seen. After local irradiation of the heart, arrhythmias never occurred, there was no increase of cardiac frequency, and no depression of ST. Spontaneous axis deviations occurred in 62%. After local irradiation of the head, arrhythmias and changes in the shape of QRS did not occur with the exception of spontaneous variation of the electrical axis. Shortly after irradiation bradycardia was marked in some cases. Axis deviations occurred in 75%. (BBB)

24582 EFFECTS OF IRRADIATION ON THE HEART. Laverde, Humberto Forero (Instituto Nacional de Cancerologia, Bogota). Unidia (Bogota), 11: 49-57(Apr.-May-June 1964). (In Spanish).

Electrocardiographic and histopathologic studies were conducted after cardiac x irradiation in 12 rabbits. The first group received single daily doses of 280 R directed through a 5 × 4 cm anterior portal toward the heart; 5 doses per week were given until a total of 4200 R was reached. The second group was given twice weekly doses of 560 R each to a total of 3920 R. The third group received 1 dose per week of 1120 R for 4 weeks, or a total of 4480 R to the anterior part of the heart. Electrocardiography was carried out periodically during the course of irradiation. Changes in the EKG were not evident until a dose exceeding 4000 R had beed received in 4 weeks, except for increases in frequency. Above this dose anomalies in the ST segment and the T wave of the EKG showed effects of irradiation on ventricular repolarization. Inversion in the T wave was noted in some animals and its height was lowered in others, as evidence of myocardial radiation injury. Histopathologic studies of the myocardium revealed vasodilatation and congestion, with signs of new formation of vessels. The muscle fibers appeared unaffected at autopsy soon after irradiation, but 1 to 2 months later some degenerative changes were seen. Pericarditis was found in 1 animal which had shown pronounced alterations in the T wave on the EKG. (BBB)

24583 CARDIAC CHANGES IN THE COURSE OF RADIATION SICKNESS. Jurkovic, V.; Vokrouhlicky, L. (Charles Univ., Hradec Kralove, Czech). pp 219-27 of Acta Secundi Conventus Medicinae Internae Hungarici, Budapest, 1963.

In experiments with nonirradiated rabbits and rabbits x irradiated by 500 and 1000 R, ventricular tachycardia was induced by aconitine and influenced by administration of procaine. The favorable influence of procaine on ventricular tachycardia in nonirradiated animals disappeared in the course of radiation sickness and procaine became a profibrillatory agent. The influence of infiltration of the cervical vagosympathetic nerves by procaine on the electrocardiography patterns was also studied. In nonirradiated animals and in the course of slight radiation sickness a change in the QRS configuration and a statistically significant occurrence of arrhythmias were caused by this blockade. The changes could be prevented by a previous injection of atropine. In the course of severe radiation sickness these changes were less frequent but were of a more serious character and could not be prevented by previous atropine treatment. The probable basis for the described changes is the change in the reactivity of the autonomic nervous system and an organic (both histological and biochemical) lesion of the myocardium in the course of radiation sickness. (BBB)

24584 PATHOLOGICAL CHANGES IN THE KIDNEYS OF RADIATION NEPHRITIS IN MAN. Dutta, L. P. (Medical Coll., Gauhati, India). Indian J. Pathol. Bacteriol., 9: 168-74(Apr. 1966).

Kidneys from 6 cases having symptoms of hypertension and renal failure that developed following abdominal radiotherapy were studied. Histological findings are described. It was concluded that initially diffuse glomerulitis develops, which ultimately results in hyalinization of the tuft capillary and a consequent atrophy of the tubules. Later fibrosis of the interstitial tissue develops. The histological findings of the terminal cases resemble those of chronic glomerulonephritis. However, interstitial fibrosis and vascular necrotic changes were more marked in these cases. (BBB)

24585 RADIATION NEPHRITIS IN MAN. Dutta, L. P. (Medical Coll., Gauhati, India). J. Indian Med. Ass., 45: 469-74(Nov. 1, 1965).

Six cases of nephritis that developed after therapeutic irradiation over the renal area are reported. Histological and clinical features of confirmed cases of radiation nephritis from the literature are analyzed and presented in a tabular form. The genesis of the main features of clinical manifestations, namely, hypertension, albuminuria, uremia, and anemia is briefly discussed. It was observed that the dose of abdominal irradiation leading to this complication is a variable one. The latent period before appearance of the symptoms and the rate of progress of the syndrome also varies greatly from case to case. Some degree of renal damage probably follows any therapeutic irradiation of the kidney region. Information so far accumulated shows that a total renal dose as low as 1750 R may initiate the kidney lesion, and may lead to clinical manifestation within a period varying from 2 months to 11 yr. The syndrome consists of a variable degree of anemia, albuminuria, hypertension, and uremia. In the 6 cases described, 5 had hypertension and 4 a high blood urea. Out of the 5 fatal cases, 3 died of uremia, 1 with cerebral hemorrhage, and 1 with cardiac failure. Histological and histochemical studies for acid mucopolysaccharides revealed tissue changes indicative of progressive fibrosis of the renal parenchyma. (BBB)

24586 AVOIDANCE CONDITIONING AS A FUNCTION OF PRENATAL X IRRADIATION AND AGE. Furchtgott, Ernest (Univ. of Tennessee, Nashville); Wechkin, Stanley. J. Comp. Physiol. Psychol., 55: 69-72(1962).

The effects of prenatal x irradiation and age at testing on the acquisition of a conditioned avoidance response were studied. Albino rats were tested at the ages of 3 to 4, 14, or 20 months, with half the rats having been irradiated with a 200 R air dose on the 16th day of gestation. A Miller-Mowrer box was used with a buzzer as the conditioned stimulus. Avoidance conditioning was more rapid in the irradiated than in the control rats. Since it was previously established that irradiation produces fearfulness, these findings are in accord with the drive theory of avoidance conditioning. The interaction of age with irradiation was not significant, suggesting that the treatment effects do not change with the age of the animal. Electric shock thresholds were significantly lower in the irradiated than in the control rats. However, the correlation between the threshold data and trials to criterion in conditioning was negligible. This indicates that the observed differences in conditioning cannot be attributed to possible differences in the unconditioned stimulus value for the two groups. Rate of avoidance conditioning decreased with age. Several hypotheses were examined to account for this finding. Analysis of response speed data indicated that this variable best accounted for the observed differences. (BBB)

24587 INDUCTION OF INFECTIOUS FRIEND VIRUS BY IONIZING RADIATION. Oboshi, Shoichi; Maruyama, Koshi (National Cancer Center Research Inst., Tokyo). Gann, 58: 95-6(Feb. 1967).

Results are reported from studies that indicate that Friend disease can be induced in newborn mice by inoculation with x-irradiated FAT-H cells. This phenomenon strongly suggests the possibility that the production of infectious virus enough to induce Friend disease might be induced by the action of ionizing radiation. (auth)

24588 PARTIAL ACQUISITION AND EXTINCTION OF AN AVOIDANCE RESPONSE IN TWO BREEDS OF SWINE. Willham, R. L.; Karas, G. G.; Henderson, D. C. (Iowa State Univ., Ames). Contract AT(11-1)-707. J. Comp. Physiol. Psychol., 57: 117-22(1964).

To evaluate the long-term genetic effects of radiation on swine the avoidance response in Duroc and Hampshire breeds were determined. Sires treated with acute 300 R doses of x radiation directed locally to the testicles were mated to females of the same breed. Sixty acquisition trials were given to 238 three-week-old progeny: 80 of these were given an additional 30 acquisition trials. In the third set of 10 acquisition trials, genetic differences within breeds were larger than in prior or subsequent sets. An analysis of variance revealed that there was no significant difference in the average number of avoidances in litters from control and exposed males. The variance for sets of 10 extinction trials averaged 1.7 times the maximum acquisition variance, yet genetic differences accounted for less of the total. Breed difference was largest during the early sets of acquisition trials and then gradually decreased until, during extinction, no significant difference was found. (B.H.S.)

24589 LUNG DAMAGE IN RATS DUE TO RADICAL X RADIATION IN HIGH-PRESSURE OXYGEN. van den Brenk, H. A. S. (Cancer Inst., Melbourne). Austral. Radiol., 10: 375-82(Nov. 1966).

One or both lungs of rats were irradiated with 3 × 1000 rads or 3 × 850 rads respectively on days 0, 7, and 14, in either air or high pressure oxygen (HPO) (45 p.s.i.) under anesthesia. Mortality within six weeks of irradiation was higher in the air group. However, more rats in the HPO group died from six weeks to nine

months after irradiation and radiographic evidence of lung damage was also higher in this group. Pulmonary damage in rats resulting from radical irradiation appears less severe than in humans. Mediastinal irradiation (3 × 850 rads) produced little evidence of lung damage by a very high incidence of damage to spinal cord (paraplegia) in both air and HPO groups of rats. The irradiation doses used to produce severe damage to skin and other tissues of the thorax and caused epilation, ulceration, and atrophy. This damage was significantly greater in HPO treated rats and confirmed previous observations made in mice (van den Brenk et al., 1961), rats (van den Brenk, 1966) and in humans (van den Brenk et al., 1966). One case of radiation sarcoma of the thoracic wall was produced in 21 rats surviving the nine months post-irradiation observation period. (auth)

24590 KARYOMETRIC STUDIES IN GRAFTED TUMORS IRRADIATED WITH 180 keV X RAYS AND WITH 30 MeV FAST ELECTRONS. III. OSCILLATIONS INDUCED IN TYPE III CELLS. Paolini, F. A. (Univ. Zurigo, Italy. Univ., Pavia, Italy). Radiol. Med., 52: 1067-77(Oct. 1966). (In Italian).

The results obtained with karyometric studies on type III cells from Ehrlich's tumor irradiated with 180 keV X-rays and 30 MeV fast electrons are presented. Comparative examination of the volumetric oscillations induced by the two types of radiation showed absence in the type III control cells of the arrangement of most frequent volumetric classes, according to the geometric doubling series, already reported by Clara in normal cells. With both the radiations used, the volumetric modifications and percentage frequency variations induced in each class presented aspects of which some were identical to those revealed in type I cells, and others comparable to those seen in type II cells. There was a tendency of the cells in question to form more homogeneous volumetric levels with the fast electrons. High statistical significance of the data obtained, revealed a different degree of effect for the two types of radiation. Variability of the ratios between the calculated regression coefficients corresponding to the different cell parts examined, for the energies is considered. (auth)

24591 THE EFFECT OF IONIZING RADIATION ON THE VARIATION OF NERVAL EXCITATION THRESHOLD LEVEL. Vanselow, K. (Univ., Kiel). Atomkernenergie, 11: 493-5 (1966). (In German).

Irradiation of the nerve membrane induced a variation of excitation threshold level. This effect is well explained, if a displacement of the electrostatic-mechanic equilibrium at the nerve membrane is assumed. The hypothesis is based on the Hodgkin theory of ionic excitation, and a mathematical relation is derived. (auth)

24592 CYTOLOGICAL ANALYSIS OF RADIATION DAMAGE AND RECOVERY OF BONE MARROW IN MAMMALS. Shmakova, N. L. (Academy of Medical Sciences, Moscow).; Yarmonenko, S. P.; Shapiro, I. M. Nature, 214: 419-20(May 13, 1967).

Cytological damage to the haematopoietic system in mammals induced by radiation is manifested by cellular interphase death, chromosome aberrations, reproduction killing, and a decrease in cell number. An attempt is made to estimate the role of these changes in the development of the acute radiation syndrome. Experiments were carried out on male mice, which were exposed to whole-body X-irradiation (dose rate 39R/min.) or to 660 MeV proton irradiation. Some received intraperitoneal injections of AET 15 min. before irradiation. Graphs are shown indicating (1) number of bone marrow cells at different times after X-irradiation with 270 R, 400 R and 700 R, or proton irradiation with a similar dose; (2) mitotic index in bone marrow at different times after irradiation; (3) percentage of bone marrow cells with chromosome aberrations at different times after irradiation; (4) percentage of degenerating cells in bone marrow at different times after X-irradiation—all with and without AET protection. (UK)

24593 CHANGES IN CELL PROLIFERATION PRODUCED BY 12 ROENTGENS OF ^{60}Co GAMMA IRRADIATION PER DAY IN THE INTESTINAL CRYPT CELLS OF 100-, 400-, AND 825-DAY-OLD BCF$_1$ MICE. Lesher, S.; Sacher, G. A. (Argonne National Lab., Ill.). Radiat. Res., 30: 654-62(Mar. 1967).

The effects of 1, 3, and 10 days of exposure to 12 R of continuous ^{60}Co γ-irradiation per day on the duration of the generation time (GT) and on the length of the four phases of the cycle—G_1, S, G_2, and M—in the crypts of the mouse small intestine were studied in 100-day, 400-day, and 825-day BCF$_1$ hybrid mice. Estimates of the time spent in the total GT and its four phases by the percent labeled mitotic figure method following the labeling of those in S were made with tritiated thymidine. These estimates show that exposure to 12 R of ^{60}Co γ-rays per day for 1 to 10 days reduces the generation time of the intestinal crypt cells in all three age groups. The reduction is accomplished in less than 3 days in 100-day and 400-day animals but may require a longer interval to reach its maximum in the 825-day mice. The reduction in GT is greatest in the old mice, but this is primarily due to the longer preirradiation generation cycle. The GT lengthens between 3 and 10 days in the two younger groups but remains the same in the older animals. All the GT changes are related to changes in G_1 in all three age groups. The very early reduction in GT in all three age groups of mice after only 3 days of exposure to 12 R/day eliminates the selection hypothesis. (auth)

24594 RADIATION STUDIES ON MICE OF AN INBRED TUMOR-RESISTANT STRAIN. THE ALTERATION OF ENDOGENOUS SUSCEPTIBILITY TO AMYLOIDOSIS BY X-IRRADIATION. Rosenblum, William I.; Goldfeder, Anna; Ghosh, Ajit Kumar (New York Univ., N. Y.). Radiat. Res., 30: 640-53(Mar. 1967).

Spontaneous amyloidosis was found to be an inherent characteristic of X/Gf mice, an inbred strain known to resist the carcinogenic or leukemogenic effects of x irradiation. Amyloid was predominantly deposited in the heart and adrenals, with lesser amounts observed in the spleen, liver, kidneys, and blood vessels. When X/Gf mice were exposed, at 2 to 3 months of age, to 300 R of whole-body x irradiation in one exposure and sacrificed 2 to 13 months later, it was found that irradiation had an inhibitory effect on the deposition of amyloid. This was demonstrated most rigorously by serial sacrifice of a large number of mice that were included in the experimental colony at the same time and, therefore, shared until their respective deaths identical environmental conditions, except for the experimental variable, irradiation. At 7 months the controls had developed extremely high levels of amyloidosis. The irradiated group had significantly less amyloid at 7 months, and, even though amyloid increased with the age of the irradiated animals, it remained significantly less, even at 15 months, than that already present in the younger, 7-month controls. (auth)

24595 ANTILOCAIZATION FOLLOWING MINIMAL FOCAL X IRRADIATION. Kahn, Rueben L.; Botzler, Richard G.; Miller, Norman S. (Univ. of Michigan, Ann Arbor). Radiat. Res., 30: 634-9(Mar. 1967).

The capacity of a tissue to localize injected microorganisms or antigens, preventing them from spreading, is a characteristic of immunity. Antilocalization has been observed following focal irradiation of rabbits. Thus, a restricted dose of diphtheria antitoxin injected subcutaneously in a focally x irradiated area of the skin of rabbits and in a corresponding nonirradiated area of controls led to increased survival of the irradiated animals from a simultaneous injection of homologous toxin. These findings indicate that the irradiated areas permitted a rapid rate of escape of the injected antitoxin, leading to the neutralization of the toxin, while the nonirradiated areas localized the injected antitoxin sufficiently to decrease the rate of its escape and its neutralization of the toxin. The irradiation doses that led to antilocalization of the antitoxin consisted of 1000, 600, 300, or 150 R; a dose of 100 R did not lead to antilocalization by the method used. The irradiated area was 8 cm in diameter; 80 kvp was employed, with no added filtration. (auth)

24596 ^{131}I-TOBACCO MOSAIC VIRUS INHIBITION OF HEMOLYSIN FORMATION IN RABBITS. Concannon, Joseph P.; Summers, Roy E.; Weil, Carrol; Cole, Christina (Allegheny General Hospital, Pittsburgh). Radiat. Res., 30: 620-33(Mar. 1967).

The purpose of this study was to investigate the mechanism and the degree of suppression of hemolysin production caused by the injection of ^{131}I-labeled tobacco mosiac virus (TMV). Six groups of rabbits were used, one group serving as untreated controls, and a second group being given 500 R of external total-body γ irradiation. The other four groups were given ^{131}I-TMV, nonradioactive TMV, ^{131}I-labeled bovine γ-globulin (^{131}I-BGG), or colloidal ^{198}Au. All groups were given sheep erythrocytes as a test antigen subsequent to the other materials. Only the groups receiving ^{131}I-TMV and 500 R of external body irradiation showed a significant depression of log peak hemolysin titer below that of the untreated controls. Since radioactive TMV did not produce a significant depression, TMV alone was probably not responsible for the suppression observed when ^{131}I-TMV was used. Neither the antigen ^{131}I-BGG, which gives a greater internal dose of total-body irradiation than ^{131}I-TMV, nor ^{198}Au, which gives a greater dose to the liver and spleen than ^{131}I-TMV, produced a significant depression of the hemolysin response. It is postulated, therefore, that the antibody inhibition produced by ^{131}I-TMV was due to the localization of ^{131}I-TMV in extrasplenic antibody forming sites. The amount of ^{131}I-TMV used in this investigation (3.09 mCi) produced a suppression of the hemolysin system equivalent to that obtained with approximately 250 R of external total-body irradiation. (auth)

24597 SKIN DAMAGE AND TUMOR FORMATION FROM GRID AND SIEVE PATTERNS OF ELECTRON AND BETA RADIATION IN THE RAT. Albert, Roy E.; Burns, Frederic J.;

Heimbach, Richard D. (New York Univ., N. Y.). Radiat. Res., 30: 525-40(Mar. 1967). (TID-22624).

Skin tumor yields after single exposures to electron and β radiation in a uniform surface pattern were compared to grid and sieve radiation patterns at several dose levels to determine whether the incidence of tumors is proportional to the amount of irradiated skin. At dose levels that produced severe ulceration in the uniform radiation pattern, the yield of tumors from the grid radiations was approximately equal to that which was predicted by summation of the expected tumor yields at each dose level over the irradiated area of skin. However, at lower doses the grid pattern produced a delayed appearance of tumors, and the sieve pattern produced fewer than the expected number of tumors throughout the experiment. This response pattern is associated with a reduction of skin damage by the grid and sieve radiation patterns. (auth)

24598 EFFECT OF PENETRATION DEPTH OF ELECTRON RADIATION ON SKIN TUMOR FORMATION IN THE RATS. Albert, Roy E.; Burns, Frederic J.; Heimbach, Richard D. (New York Univ., N. Y.). Radiat. Res., 30: 515-24(Mar. 1967). (TID-22623).

Acute skin damage and epithelial skin tumor formation were studied in albino rats exposed to graded doses of electrons having maximum ranges in skin of 0.36 mm, 0.75 mm, and 1.40 mm. Tumor formation and acute injury were found to be highly dependent on the penetration of electrons for a wide range of surface doses. There is a critical depth in skin of 0.27 mm where the dose dependence of the tumor yield is independent of the penetration depth of the electron radiation. (auth)

24599 MAMMARY NEOPLASIA IN THE RAT AS RELATED TO DOSE OF PARTIAL-BODY IRRADIATION. Shellabarger, Claire J.; Schmidt, Robert W. (Univ. of Michigan, Ann Arbor). Radiat. Res., 30: 497-506(Mar. 1967).

Female Sprague–Dawley rats were exposed to 250-kvp x rays at 42 days of age so that the anterior half of the animal received either 0,222 R, 444 R, 666 R, 888 R, or 1110 R in a single exposure. The animals were studied over their entire life span. The life span was reduced increasingly with increasing dose. The non-exposed animals had similar rates of mammary neoplasia in the anterior and posterior areas. Mammary neoplasia was much more prevalent in the anterior, exposed area than in the posterior, shielded area. Within the anterior, exposed area the incidence of mammary neoplasia increased in an approximately regular manner as the dose was increased from 222 R to 888 R. The mammary neoplasia response to 1110 R was less than the response to 888 R and often less than the response to 666 R when calculated on a rat-day at risk basis. The decline in mammary neoplastic response at 1110 R was thought to be the result of cell death of mammary tissue cells, some of which would have been expected to develop neoplasia. (auth)

24600 EFFECT OF TRITIATED THYMIDINE ON MORTALITY AND TUMOR INCIDENCE IN MICE. Johnson, Horton A.; Cronkite, Eugene P. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 30: 488-96(Mar. 1967). (BNL-10289).

An investigation of the late effects of tritiated thymidine in Swiss albino mice is discussed. The compound (specific activity 1.9 Ci/mmole) was injected intraperitoneally into female animals 6 to 12 weeks of age. Three hundred animals received 5 μCi/gm of body weight, another 300 received 1 μCi/gm of body weight, 300 served as controls, and 100 served as radiation controls, receiving 400 R of γ radiation. Animals were allowed to live out their full life spans, which were recorded along with autopsy findings. Mean life spans and age-specific mortality rates of mice injected with tritiated thymidine were indistinguishable from those of control animals. There was no measurable alteration in tumor incidence, tumor type, or time of onset of neoplasia that could be attributed to the injection of this compound. (auth)

24601 THE GAMMA RADIATION $LD_{50/30}$ FOR THE RABBIT. Pryor, William H. Jr.; Glenn, William G.; Hardy, Kenneth A. (Air Force School of Aerospace Medicine, Brooks AFB, Tex.). Radiat. Res., 30: 483-7(Mar. 1967).

White New Zealand rabbits were exposed to acute whole-body γ-radiation from a ^{60}Co source. Total doses were 900, 950, 1000, 1050, 1100, 1150, and 1200 R, with 20 animals exposed at each level. The dose rate was 100 R/min. A probit analysis on the results indicated an estimate of the $LD_{50/30}$ to be 1018 R with 95% confidence limits of 973 to 1054 R. The mean time of survival is presented for each group as well as deaths per group at 2-day time intervals postirradiation. A bimodal death pattern was observed. (auth)

24602 THE EFFECT OF RADIATION ON SOME FUNCTIONAL AND METABOLIC PARAMETERS OF ISOLATED RAT STOMACH, IN COMPARISON TO SPLEEN CHANGES. Cummins, Joseph T.; Kohl, Herbert H.; Vaughan, Burton E. (Naval Radiological Defense Lab., San Francisco). Radiat. Res., 30: 557-62(Mar. 1967).

Studies on the effect of x radiation on the gastric bioelectric potential of the rat show that the potential rose on the third day and fell on the seventh. Acid secretion also was significantly increased on the seventh day. In the gastric mucosa, there were no corresponding changes in ATP or phosphocreatine (PC) levels, as determined enzymatically. In spleen there was the expected lowering of ATP with irradiation, but the level of PC was not changed. Changes in acid secretion rate and in transmural bioelectric activity were substantially influenced by neurological factors apart from radiation. A radiation effect on metabolism resulting in changes in gastric phosphate levels was not indicated by the findings. (auth)

24603 THE ASSOCIATION BETWEEN CHRONIC RADIATION DAMAGE OF THE HAIR FOLLICLES AND TUMOR FORMATION IN THE RAT. Albert, Roy E.; Burns, Frederic J.; Heimbach, Richard D. (New York Univ., N. Y.). Radiat. Res., 30: 590-9(Mar. 1967). (TID-22625).

Chronic follicle damage has been studied after single exposures to graded doses of electrons at various depths of penetration by the use of whole mounts of rat skin. Chronic radiation-induced follicle damage is manifest by complete loss of follicles as well as by various grades of follicle atrophy. In the non-ulcerogenic dose range, the dose-incidence curves for atrophic follicles and tumors are remarkably similar, and the ratio of tumors to atrophic follicles is 1/2000 to 1/4000. Evidence is presented which indicates that the induction of chronic hair follicle damage is an important factor in the formation of epithelial skin tumors. (auth)

24604 SENSITIVITY OF ARTEMIA EGGS TO THE γ-IRRADIATION. VI. THE EFFECT OF FRACTIONATED IRRADIATION. Iwasaki, Tamiko (National Inst. of Radiological Sciences, Chiba, Japan). Mem. Coll. Sci., Univ. Kyoto, Ser. B, 32: 177-83(Mar. 1966).

The effects of fractionation of γ-irradiation on the hatchability of dry eggs of Artemia were studied. The eggs were irradiated twice with 240 kR at intervals of one, three, and seven days, respectively. When the eggs were stored at dry ice temperature after the first irradiation, the total effects of fractionated irradiations were nearly the same as those of a single irradiation with 480 kR. On the other hand, the irradiated eggs were stored at 25°C, the ultimate decrease in hatchability was much higher than that after a single irradiation with 480 kR. The effect increased as the time interval between two irradiations increased. The eggs were subjected to irradiation with 480 kR fractionated into two doses at different ratios, 120:360 kR, 240:240 kR and 360:120 kR, respectively. When the eggs were kept at dry ice temperature during one week between two irradiations, the ultimate hatchabilities always remained nearly at the level of that caused by a single irradiation with 480 kR, irrespective of differences in the dose ratio between two irradiations. At 25°C, on the contrary, the hatchability became lower as the dose ratio of the first irradiation to the second one increased. (auth)

24605 CARCINOMA OF THE THYROID IN CHILDREN AND YOUNG ADULTS: IATROGENIC RELATION TO PREVIOUS IRRADIATION. Hagler, Sumner; Rosenblum, Philip; Rosenblum, Arthur (Michael Reese Hospital, Chicago). Pediatrics, 38: 77-81(July 1966).

A review of 26 articles published since 1949 that support the concept that irradiation of the head, neck, or chest in infants and children was a causative factor in the development of carcinoma of the thyroid in young people is presented. Some new cases are also presented. Fifteen cases of carcinoma of the thyroid and four cases of thyroid adenoma in children and young adults were reported. In all except one case, irradiation had been given to the head, neck, or chest of these patients five to 17 years previously. Observations suggested that carcinoma of the thyroid in children was related to radiotherapy. The cases represented a remarkably high incidence of thyroid neoplasia occurring in a single pediatric office. Females predominated over males in the carcinoma group in a ratio of 13 to two. In the adenoma group there were two males and two females. Total radiation doses were listed. The smallest dose was 250 R, and the largest dose was 1500 R. Studies of the relation of radiation dose to the subsequent development of carcinoma of the thyroid indicated a threshold level of about 180 R. It was stressed that irradiation of the head, neck, or chest of infants and children should be avoided whenever possible. (BBB)

24606 ULTRAVIOLET IRRADIATION OF CATTLE IN RELATION TO DIAPAUSE IN THE HORN FLY, HAEMATOBIA IRRITANS (L.) (DIPTERA: MUSCIDAE). Depner, K. R. (Canada Agriculture Research Station, Lethbridge, Alta.). Intern. J. Biometeorol., 9: 167-70(Oct. 1965).

The effect of uv irradiation of the host on the development of Haematobia irritans (L.) was studied. The number of pupae in diapause in each phase of the experiment was found to be significantly lower in populations of flies that fed on uv-irradiated cows than in populations of flies that fed on cows that had not been irradiated for at least 3 weeks. In phase A there were 8.01% fewer pupae in diapause in progeny from flies on the uv-treated cow than from those on the untreated cow. The same effect was seen in phase B and phase C with differences of 15.06 and 11.11%, respectively. It was concluded that the horn fly utilized the effect of uv radiation on the metabolism of its host in regulating the preparation of its own progeny for survival through the following winter although the insect, since it is an external parasite, is exposed to uv radiation equally as much as is its host. It was suggested that the insect, although it has only a short life span and lays its eggs soon after it becomes an adult, is immediately able to transmit the uv radiation effect to its offspring by utilizing the blood of the host that has already had many weeks of conditioning. Also, that ultraviolet radiation was an important factor in combination with photoperiod and temperature in the regulation of seasonal variations in the physiology of parasites of warm-blooded animals. (TSS)

24607 PHOTOBIOLOGY OF THE SKIN. Burckhardt, W. (Staedtische Dermatologische Poliklinik, Zurich). Hautarzt, 16: 49-54(Feb. 1965). (In German).

The author reviews the role of electron spin resonance in study of photobiological effects of uv radiation on the skin; the effects of uv irradiation in the range of 2500 to 3000 Å and its relation to skin thickness and pigmentation; the effects of uv radiation on chemical compounds and enzymes in the skin; the effects of uv radiation combined with chemical compounds on the incidence of skin carcinoma and other photoinduced dermatoses; the induction of photoallergic dermatoses by fluorescent materials; the effects of drugs and uv irradiation on induction of photoallergic dermatoses and various types of photobiotropism; and the chronic phototraumas and carcinomas caused by light alone. (140 references.) (BBB)

24608 IRRADIATION EXPERIMENTS WITH TRIBOLIUM. Sokoloff, A. (California State Coll., San Bernardino). Tribolium Inform. Bull., 4: 28-33(Mar. 1961).

Male and female 3-day-old adults of T. castaneum and males of T. confusum were treated with whole-body x radiation doses of 1500, 3000, and 6000 R. Females were mated with unirradiated males when they were 6 days old (3 days after irradiation). In these fertility studies, the primary effect of x radiation was observed to be at the egg stage, i.e., if any eggs hatched into larvae nearly all of the larvae reached the adult stage. Females were highly susceptible to the 6000 R dose; even though some females receiving this dose survived to lay eggs, although none were viable. Normal T. castaneum females, mated to 3000-R x-irradiated males produced fewer offspring than the reciprocal cross. The difference was attributed in part to death or sterility of irradiated males. Some males were not affected as drastically as females by 6000 R since they produced a few offspring (less than 1% of the controls). T. confusum was more susceptible than T. castaneum to 6000 R. The 3000-R x-irradiated males of both species experienced the same recovery phenomenon and it occurred at the same time for both species: from day 11-46 (the age of the parents) the number of offspring of both species of beetles fell gradually and approached zero. Later, males produced viable sperm and the effect of x radiation was passed to the next generation. In T. castaneum, controls produced almost 96 adults per female, whereas the F_1's produced only 63 adults per female. The effect was more severe in T. confusum, since the F_1's produced only 31 adults per female, as compared to 90 offspring per female recorded for the controls. The sex ratio was 1:1. Genetic studies in quest of sex-linked lethal mutations induced by x rays were negative. Both the wild type controls and the x-irradiated insects were examined for visible mutations through the second generation. The following visible mutations were found: blistered elytra, deformed forelegs, split elytra, and pink eyes. (BBB)

24609 ENERGY EXPENDED BY ALPHA PARTICLES IN LUNG TISSUE. II. A COMPUTER METHOD OF CALCULATION. Haque, A. K. M. M. (Borough Polytechnic, London). Brit. J. Appl. Phys., 18: 657-62(May 1967).

A computer program was used to calculate the energy expended by α particles in human respiratory tissue. The method of computation is more general and the results are an improvement on those of previous work because of the elimination of several approximations. N_{eq} values for trachea (18,000 μm diameter), segmental bronchi (3500 μm diameter) and respiratory bronchioles (600 μm diameter) recalculated, and those for lobar bronchi (8300 μm diameter) and bronchioles (1540 μm diameter) added. Energy expenditures at points inside the tissue, 5 and 10 μm from the surface of deposition, were also computed. In general, the recalculated values are smaller than those previously obtained. The overestimation, which varies from about 5 to 35%, is less significant for deeper points in the tissue; also, the over-estimation is higher in narrow airways than in broad. The accuracy of the present procedure is limited only by that of the relative $-dE/dx$ values of the α particles employed for the computation. (auth)

24610 MECHANISM OF RADIATION INDUCED GRANULOCYTOSIS. Rixon, R. H.; Baird, K. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nature, 213: 388-9(Jan. 28, 1967).

An early and transient rise in the number of circulating neutrophilic granulocytes occurs in the blood of mammals, including man, after radiation exposure. Neither the etiology of this effect nor the source of the mature neutrophils has been established. The evidence discussed in the present communication suggests that the granulocytosis is due to release of one or more pharmacologically active biogenic amines, which mobilise large intravascular reservoirs of mature neutrophils. (INIS-UK)

24611 EARLY METABOLIC LESION FROM β IRRADIATION OF NERVOUS TISSUE IN VITRO. Berger, J.-P.; Dolivo, M. (Univ., Lausanne, Switzerland). Helv. Physiol. Pharmacol. Acta, 24: C8-C9(1966). (In French).

The effect of β radiation on the isolated cervical sympathetic ganglion of the rat was studied. By supplying only glucose as a source of energy, the transmission of nervous impulses could be maintained for more than 30 hr. A ^{90}Sr source was used to produce an exposure rate of 2.7 rads/min for exposure periods of 7 to 120 min, giving total doses of 20,000 to 320,000 rads. The ganglion did not show changes in nervous function or metabolic activity (glucose uptake and lactate production) until doses of 160,000 rads were reached after tests with doses of 20,000 to 320,000 rads. A 20% reduction of glucose uptake was noted after a dose of 160,000 rads. When irradiation occurred in oxygenated media, 80,000 rads was sufficient to depress glucose utilization and lactate production. After 80,000 rads irradiation the activity of lactic dehydrogenase in the tissue was not diminished. (BBB)

24612 INHIBITION OF O_2 UPTAKE OF RAT JEJUNUM BY X IRRADIATION IN VITRO. PROTECTION BY CYSTEAMINE. Balasch, J.; Ponz, F. (Univ. of Barcelona). Rev. Espan. Fisiol., 22: 99-104(1966).

Rat jejunum strips were exposed to 5000-, 10,000-, and 20,000-R doses of x rays and their respiration determined. After 5000 R the irradiated strips took up slightly less O_2 than the nonirradiated control strips. The difference became greater after irradiation with 10,000 R. The decrease in the O_2 uptake was slight at the beginning of the experiment, and progressively became more marked after about 2 or 3 hr of manometric recording. In another experiment the strips were placed in Warburg flasks which contained glucose (2.77 mM). Under these conditions the O_2 uptake increased because of the presence of this metabolizable substrate. Irradiation with 20,000 R then produced a marked fall in the respiratory activity of the tissue. Addition of 0.02M cysteamine to the solution surrounding the strips prevented the drop in O_2 uptake caused by irradiation, demonstrating another aspect of the radioprotective effect of cysteamine. (BBB)

24613 MICROPUNCTURE OF CELLS BY MEANS OF A LASER BEAM. Bessis, Marcel (National Center of Blood Transfusion, Paris); Ter-Pogossian, Michel M. Ann. N. Y. Acad. Sci., 122: 689-94(May 28, 1965).

The effect of ruby laser irradiation in the form of a microbeam (2.5 μ dia) on cells was studied. To avoid possible damage to the eye, the eye pieces of the microscope were fitted with special screens that absorbed the wavelength of the laser radiation and the effect of micropuncture was observed by a closed circuit television system. The energy was delivered in a very short period, and under such conditions the irradiated area was raised to extremely high temperatures. All substances absorbing the wavelength emitted by the laser could be destroyed and they alone were destroyed. When apparently colorless cells, such as white cells, were exposed to the laser beam, no effect was observed. If the cells were stained by vital stains such as Janus green or neutral red, which absorb near the wavelength of the laser, the cells exploded. Certain organelles could be selectively destroyed by staining them selectively with low concentrations of these dyes. The absorbing substances, such as colloidal carbon, could be introduced by phagocytosis. Definite effects could be observed on cells the absorption of which was considered negligible for the wavelength under consideration. When red cells were exposed to the laser beam, they were coagulated. With a lower intensity the circular mark of the laser spot was seen, then after a few minutes the cell was progressively discolored by hemolysis except for the spot where the hemoglobin was coagulated by the beam. (BBB)

24614 SEVERE RADIODERMATITIS CAUSED BY AN INDUSTRIAL ACCIDENT WITH A FLUOROSCOPE (KRISTALLO-

FLEX). Sanderink, J. H. F. Ned. Tijdschr. Geneesk., 110: 682-4(Apr. 2, 1966). (In Dutch).

Skin lesions were caused by a dose of 16,000 R received while the patient was handling the test chamber of a Kristalloflex fluoroscope. Several days later the finger became red, and after a week blisters and pain accompanied the inflammation. The back side of the fingers of the right hand and the distal side of the back of the hand, as well as the left index finger, were swollen with erythema and edema, with blisters and ulceration of the right index and middle finger and the left index finger. Treatment was given locally with 0.1% triamcinolone-acetonide and 1% neomycin sulfate salve, and the patient also received dextromoramine. Blistering and ulceration on these fingers and pain continued. No indications of radioinjury were found in the eyes, nor in blood or urine. After 14 months ulcerations and complaints of pain caused an examining committee to recommend amputation of the right index finger and skin grafting on the right middle finger, which were carried out. The remaining fingers of the right hand and the left index finger show clear roentgen atrophy. (BBB)

24615 SQUAMOUS EPITHELIAL CARCINOMA OF THE KIDNEY WITH SARCOMA-LIKE PARTS FOLLOWING THOROTRAST PYELOGRAPHY. Pfeifer, Kurt (Staedtische Oskar-Ziethen-Krankenhaus, Berlin). Zentralbl. Allgem. Pathol. Pathol. Anat., 107: 556-65(Aug. 31, 1965). (In German).

A patient who had undergone retrograde Th = O_2 pyelography 30 yr previously was nephrectomized. Diagnosis of the removed kidney showed squamous cell carcinoma extending from the kidney pelvis, with areas of Th deposition that resembled sarcoma. Autoradiograms showed multiple areas of star shaped areas of α tracks, which extended outward from the deposits of Th in the interstitium. The author compared this case with 23 other cases of kidney tumors induced by ThO_2 deposition reported in the literature, and suggested that very strict standards should be applied to their diagnosis as mixed tumors. If there is not sufficient evidence available of undifferentiated mesenchymal elements undergoing blastomatous growth, the growth should be described as a carcinoma with sarcomatous elements (carcinoma sarcomatodes). The usual latent period between Th treatment and appearance of kidney tumors is probably of the order of 30 yr rather than some of the rather short periods of 12 to 18 yr have been reported. Because Th treatment was used even beyond 1946, additional cases of tumors induced by Th should be expected for the next 2 decades. Usually, the patients who have received ThO_2 treatment are unaware of it and so the kidney tumors that result from it are discovered incidentally to x-ray examinations. References cited, 73. (BBB)

24616 RADIATION EFFECTS ON ELECTRICAL AND MECHANICAL ACTIVITY OF SKELETAL MUSCLES IN FROGS. Saneblidze, O. I.; Nadareishvili, K. Sh.; Shafir, Yu. Ya. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 45: 499-506(Feb. 1967). (In Russian).

Experiments with isolated preparations of sartorius, gastrocnemius, and rectus abdominis muscles of frogs showed that contractility was affected by irradiation. The initial radiation effect was a short term depolarization of striated muscle cells. The membrane potential was dose-dependent, and recovery of electric potential 1 to 3 min postirradiation was independent of dose rate. Further irradiation reduced electrochemical polarization of the muscle cell membrane with clearly expressed changes occurring only at very high doses. (R.V.J.)

24617 STUDIES ON THE SIGNIFICANCE OF TAURINE IN ACUTE RADIATION INJURY. Abe, Mitsuyuki (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 466-80(Aug. 1966). (In Japanese).

From the 10th day after irradiation with a sublethal dose taurine excretion increased markedly, parallel with the increase in the mortality-rate of irradiated mice. This suggests that the loss of taurine in irradiated mice may have some important influence upon the radiation-induced death of mice. The therapeutic effect of taurine, i.e., increase in the survival-rate, was observed when it was given from the 2nd post-irradiation day, but was especially pronounced when it was given on the 4th day after irradiation. The amount of urinary excretion of taurine was minimum on the same day. This means that the therapeutic effect of taurine is most prominent if it is given when the taurine-level in the body reaches minimum. Administration of taurine after irradiation promoted the recovery from radiation-induced leucopenia. The mechanisms of the increased excretion of taurine after whole body irradiation was discussed. The taurine-level in the liver or muscle was decreased little by irradiation, but the taurine content in the spleen decreased markedly from the 2nd day after irradiation. The amount of incorporated taurine-^{35}S into the spleen was greater than that into the liver or muscle and the incorporated taurine-^{35}S into the spleen of irradiated mice was greater than that into the spleen of non-irradiated normal mice. The mechanism of the therapeutic effect of taurine may be on enhancement of the taurine level in lymphoid tissues, leucocytes and thrombocytes which lose taurine possibly because of the radiation-induced damage to the cell membranes. (TSS)

24618 THE EFFECT OF ULTRAVIOLET RADIATION ON THE STEM AND BULB NEMATODE DITYLENCHUS DIPSACI (KUEHN). Green, C. D.; Webster, J. M. (Rothamsted Experimental Station, Harpenden, Eng.). Nematologica, 11: 638-42(1965).

Suspensions of fourth stage larvae of Ditylenchus dipsaci were exposed to uv radiation (254 nm) at doses from 16 to 84,000 erg/cm^2. The greater differences in the reproductive potential of non-irradiated nematodes in onions as compared with irradiated ones suggested that pathogenicity of the nematodes was partially eliminated by uv radiation. The nematodes did not reproduce after doses of 100 erg/cm^2; were immobilized after 10,000 erg/cm^2; and ruptured after 80,000 erg/cm^2. (BBB)

24619 EFFECTS OF 1000-R WHOLE-BODY X-IRRADIATION ON DNA SYNTHESIS AND MITOSIS IN THE DUODENAL CRYPTS OF THE BCF_1 MOUSE. Lesher, S.; Sallese, A.; Jones, M. (Argonne National Lab., Ill.). Z. Zellforsch. Mikroskop. Anat., 77: 144-6(1967).

Thymidine-^3H was used to study the effects of 1000 R, whole-body x irradiation on the proliferative cells of mouse duodenal crypts during the four phases of the generation cycle: namely, the DNA synthesis phase, S; the premitotic gap, G_2; the division phase or mitosis, M; and the presynthesis gap, G_1. G_1 and G_2 are characterized only by the fact that no DNA synthesis is taking place in these phases. In the intestinal crypts of BCF_1 mice, a 1000 R dose blocked cells in G_2 for about 18 hr, and reduced the number of cells in S to less than one-half that observed in control animals during the first 12 hr after exposure. Cells synthesizing DNA and cells undergoing division remained few in number for more than 48 hr. Between 48 and 72 hr a compensatory reaction had begun and the number of cells in M and S increased from 28 at 48 hr to 150 at 72 hr; a mean value of 482 was reached at 96 hr. (BBB)

24620 CAUDA EQUINA DAMAGE AFTER THORIUM DIOXIDE MYELOGRAPHY. Tucker, Howard J.; Sibley, William A.; Lapham, Lowell W. (Western Reserve Univ., Cleveland). Acta Radiol., Diagn., 5: 1147-54(1966).

Case histories are reported for 4 patients who developed signs of progressive damage to the Cauda equina many years after ThO_2 myelography. The number of years elapsing between myelography and first symptoms of neural damage was inversely proportional to the amount of retained Thorotrast in the lumbosacral spinal canal. The clinical localization and extent of neurologic damage correlated with the position and estimated volume of residual contrast media. All 4 patients had been examined by Thorotrast myelography in the early 1940's for clarification of acute low back pain or sciatica. Regardless of the nature of the original illness the pain which prompted Thorotrast myelography subsided in all patients, either spontaneously or after operation. Then, after a lengthy symptom-free interval (range: 5 to 15 years), each patient developed a neurological disturbance. The most common symptoms and signs of ThO_2 inquiry were urinary and fecal incontinence, absent ankle reflexes, and weakness of the legs. In most cases urinary incontinence was the initial symptom. The extent of motor and sensory loss was variable and correlated with the amount and location of residual Thorotrast. Both clinical and experimental evidence showed that the central nervous system is more radiosensitive than the peripheral nerve fibers. However, it is likely that the spinal cord was spared in these cases following Thorotrast myelography because of the distance of the retained contrast medium from the spinal cord in some of the cases, and because of the short range of α rays. The α-ray-emitting properties of Th are most important in causing direct damage to tissue, and the most severe disruption of function should occur in areas of highest concentration of residual Thorotrast, probably in the nerve roots as they emerge from the spinal canal. (BBB)

24621 SIGNIFICANCE OF THE DISTURBANCE OF TRYPTOPHAN METABOLISM IN RADIATION INJURY. Abe, Mitsuyuki (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 298-301(June 1966). (In Japanese).

DL-Kynurenine, L-Kynurenine and DL-tryptophan reduce the survival rate of mice after whole body irradiation. Urinary excretion of xanthurenic acid in mice was shown to increase after fractionated irradiation and 39% of the irradiated mice died of leukemia. Direct relationship between the increase in urinary excretion of xanthurenic acid and the incidence of leukemia could not be observed. However, it was suggested that the disturbance of tryptophan metabolism may occur in mice with radioinduced leukemia. The significance of the disturbance of tryptophan metabolism in radiation injury was discussed. (NSA of Japan)

24622 THE INCREASE IN MALE ADULTS BY GAMMA-RAY IRRADIATION IN THE ROOT-KNOT NEMATODE, MELOIDOGYNE INCOGNITA CHITWOOD. Ishibashi, N. (Central Agricultural Experiment Station, Saitama, Japan). Nematologica, 11: 361-9(1965).

The γ irradiation (^{60}Co) of genital primordia of Meloidogyne incognita Chitwood before sexual differentiation increased the percentage of small male adults (0.7 mm body length) with one testis (early irradiation). On the 11th day after irradiation, the percentages of male larvae were 1.5%, 18.3%, and 27.2% in the nonirradiated control, 10-kR, and 20-kR irradiated groups, respectively. Irradiation retarded growth of the nematodes in proportion to the dose. On the other hand, irradiation when the gonads were developing from cotyloid-shaped to V-shaped forms increased the number of large males (1.5 mm body length) with 2 testes (late irradiation). Ten days later, the percentage of the males was 1.6% in the nonirradiated control, and 24.9% and 33.5% in the 10-kR and 20-kR irradiation groups, respectively. Retardation of growth by this late irradiation was less than that caused by the early irradiation, and there was little difference in retardation between 10-kR and 20-kR doses. (BBB)

24623 EFFECTS OF RADIATION ON FROG EGGS. II. DIPLOID AND HAPLOID EGGS WITH HEAVILY γ-IRRADIATED CYTOPLASM. Sambuichi, Hajime (Univ. of Michigan, Ann Arbor). Embryologia (Nagoya), 9: 196-204(Oct. 1966).

Rana nigromaculata eggs exposed to 49.2 to 98.4 KR of ^{60}Co γ rays before insemination developed androgenetically after insemination with normal sperm. The cleavage rate and developmental capacity of these eggs were markedly reduced with an increase of the dose and most of these eggs became abnormal embryos or tadpoles. After nuclear transfers to cytoplasm that had been heavily irradiated, the cleavage rate was nearly constant, irrespective of the dose of irradiation. Some of these nuclear transfers developed normally and grew into frogs. Both gynogenetic and androgenetic haploid tadpoles were similar in their viability. There was also no marked difference in viability between tadpoles from control and experimental (irradiated) nuclear transfers. It is suggested that heavily irradiated cytoplasm had no effect on the developmental capacity of frog eggs, except for that on fertilization and cleavage. (BBB)

24624 USAGE OF ^{75}Se AND ^{134}Cs IN GAMMA IRRADIATION STUDIES. Patrick, H.; Martin, W. G. (West Virginia Univ., Morgantown). Proc. W. Va. Acad. Sci., 37: 23(1965).

Retention of ^{75}Se and ^{134}Cs was studied in young (180-g) rats or 21-day-old White Leghorn cockerels which were irradiated using a ^{137}Cs irradiator designed to handle 120 rats or cockerels at one time at a dose rate of 180 R/hr, or to handle one group (10 rats or chicks at one setting) at each of the following rates: 800, 700, 600, 400, 200, 100, 50, or 25 R/hr. Irradiation time was 2 hr. Irradiated rats retained the ^{75}Se longer than normal animals. The ^{75}Se passed into the protein fraction of serum, muscle, and spleen, and was apparently not excreted until the protein had been catabolized. The ^{75}Se content per spleen from rats or chicks decreased as the dose of irradiation increased from 50 to 1600 R. Irradiated rats fed a simplified low-fiber ration showed less urinary and greater fecal ^{134}Cs excretion than normal animals, whereas irradiated rats fed a simplified ration, plus hydrobiotite flakes as a Cs-complexing agent, showed greater urinary and less fecal excretion. The kidney tubules apparently were damaged so that the Cs could not be readily reabsorbed and recycled into the intestine to be complexed by the hydrobiotite. Irradiation increased the biological half-life of ^{75}Se in rats and decreased that of ^{134}Cs. With ^{75}Se this was apparently due to a slowing up of protein metabolism, and in the case of ^{134}Cs it was due to membrane permeability and control of absorption. Sensitivity of the spleen of both rats and chicks to irradiation as measured by ^{75}Se retention allows this organ to be used for dosimetry studies as well as studies on the influence of irradiation on blood protein. Also ^{134}Cs can be used to measure membrane permeability. (BBB)

24625 STRUCTURAL AND CYTOLOGICAL STUDIES ON INJURY AND REGENERATION OF THE RAT BONE MARROW FOLLOWING TOTAL BODY IRRADIATION. Adachi, Yamao (Tokyo Medical and Dental Univ.). Bull. Tokyo Med. Dent. Univ., 13: 35-57(Mar. 1966).

Male Wistar rats were exposed to a single dose of x rays (500, 700, or 1000 R) and the development of injury and regeneration in bone marrow was studied hematologically, histologically, electron microscopically, histochemically, and histoautoradiographically. Structural and cytologic alterations of the bone marrow, especially of the hematopoietic cells and reticuloendothelial cells are described. Distribution of the regenerative foci of myeloid and erythroid cells in the bone marrow was examined by serial sectioning. Prior to the recovery of the peripheral leucocyte count, regeneration of immature myeloid cells in bone marrow appeared, as demonstrated with the myelograms and electron micrographs. Noted particularly was the movement of blast cells and nonphagocytic reticular cells which were found to be dominant especially in the subsinusoidal region in the control and experimental animals. At the regenerative phase, blast cells labeled with ^{3}H-thymidine increased in number, significantly in the subsinusoidal layer. Nonphagocytic reticular cells were also found to have proliferated in this area. It was shown that the bone marrow fat cells could be derived from these subsinusoidal nonphagocytic reticular cells. However, it was not determined whether or not such subsinusoidal reticular cells can differentiate into other kinds of bone marrow cells taking part in hematopoiesis. (BBB)

24626 EMPERIPOLESIS AND LEUKOCYTE NECROSIS IN CELL LINES OF THE DUODENAL CRYPT IN IRRADIATED MICE. Hugon, Jean; Borgers, Marcel (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). J. Microscop., 5: 649-54(1966). (In French).

Ionizing radiation causes an increase in penetration of the intestinal mucosa by leukocytes (emperipolesis), and causes changes in various types of cells in the mucosa, as seen by electron microscopy. These studies were conducted in BALB/C+ mice, 12 weeks old, irradiated with a single 1350-R, whole-body dose of 300-Kv x rays. The fine structure of intraepithelial leukocytes in the duodenum was examined 1, 2, and 3 hr postirradiation. At 1 to 2 hr in the basal part of the epithelium some unusually electron-dense cells were consistently observed. The nucleus occupied most of the cell and had an inhomogeneous form consisting of granulated masses. The cytoplasm was very compact. The endoplasmic reticulum was slightly dilated and the mitochondria had an irregular appearance. The cell membrane was indistinct and the pseudopods of the leukocytes had disappeared. At 2 hr postirradiation some duodenal crypt leukocytes showed, in their basal portions, voluminous inclusions 3 to 5 μ in dia, surrounded by a double membrane. Around these inclusions, vacuoles were present, probably representing phagocytized small lymphocytes, undergoing degeneration. (BBB)

24627 MAMMALIAN EQUIVALENT OF THE AVIAN BURSA OF FABRICIUS. Cooper, Max D.; Perey, Daniel Y.; McKneally, Martin F.; Gabrielsen, Ann E.; Sutherland, David E. R.; Good, Robert A. (Univ. of Minnesota, Minneapolis). Lancet, 1: 1388-91(June 25, 1966).

Parallel experiments were done in chickens and rabbits by removing the bursa of Fabricius from chickens and the bursa-like lymphoid tissue of the gastrointestinal tract (the appendix, Peyer's patches, and sacculus rotundus) from the rabbits. All experimental groups were irradiated with 650 R doses of x rays, allowed to recover, and then evaluated for immunologic ability. The results supported the hypothesis that the rabbits had a selective failure of antibody-producing capacity paralleling the failure of bursectomized and irradiated chickens, but were just as capable of cellular immune responses as the irradiated control animals. Thus, bursectomy and near-lethal irradiation of 12-week-old chickens significantly depressed antibody response to bovine serum albumin and brucella organisms at 19 weeks compared to the antibody responses of control-irradiated birds. The analogy to the bursectomized and irradiated chickens was striking. This parallel extended to the lymphoid tissue morphology as well; as in the chickens, plasma cells and germinal centers seemed to be present in normal numbers in the lymphoid tissues of the surgically manipulated rabbits. A difference was observed, however, in comparing the immunoelectrophoretic analyses of γ-globulins of the sera of the two groups of rabbits. In surgically manipulated and irradiated rabbits, it was not possible to detect the precipitin line of a γ-migrating protein that was clearly visible in serum-immunoelectrophoretic patterns of all controls. The immunological deficiency of the surgically manipulated and irradiated rabbits did not extend to the cellular immune responses tested. The animals developed delayed tuberculin allergy and rejected homografts as well as did the irradiated controls. Consonant with this evidence of intact cellular immunity were the normal numbers of small lymphocytes in the circulation and in the popliteal lymph nodes. These observations support the hypothesis that the Peyer's patch type of lymphoid development in the gastrointestinal tract of mammals is the functional equivalent of the bursa of Fabricius of birds. (BBB)

24628 "SMALL CLONES" IN IRRADIATED TUMOUR CELLS IN VIVO. KINETICS OF REGROWTH OF MURINE LEUKAEMIA CELLS SURVIVING IRRADIATION WITH X RAYS, FAST NEUTRONS, AND ACCELERATED CHARGED PARTICLES. Berry, Roger J. (Churchill Hospital, Oxford). Brit. J. Radiol., 40: 285-91(Apr. 1967).

The growth of the intraperitoneally injected P-388 lymphocytic leukemia cells were studied in vivo, with unirradiated cells and with cells surviving after irradiation under anoxic conditions with x rays, fast neutrons, and accelerated charged particles. Maxi-

mum delay in re-growth of tumor cells after irradiation occurs when re-growth takes place from the smallest possible number of surviving cells. The fact that this delay in re-growth can exceed the mean time from inoculation of one unirradiated tumor cell to death of the recipient animal strongly suggests a reduction in the growth rate of some surviving cells analogous to the formation of small clones after irradiation of mammalian cells in vitro. The rate of re-growth of tumor cells surviving fast neutron irradiation of intermediate LET (14 MeV monoenergetic neutrons and 6 MeV cyclotron-produced fast neutrons) is no more rapid than that of tumor cells depopulated to the same degree by irradiation with low-LET x rays and accelerated charged particles; in fact the intermediate-LET fast neutron irradiation appears to produce a slightly higher percentage of slow-growing tumor cells among those which survive. The RBE for tumor regrowth after irradiation with fission-spectrum (high-LET) fast neutrons is only slightly lower than the RBE of the same radiation for producing cell productive death. (auth)

24629 THE EFFECTS OF X RADIATION ON PERITONEAL HEALING: AN EXPERIMENTAL STUDY. Venables, C.; Ellis, Harold; Burns, J. E. (Westminster Hospital, London). Brit. J. Radiol., 40: 275-9(Apr. 1967).

A single dose of 1,500 R can be given to an area of peritoneum in the rat with no effect on the rest of the animal, provided that adequate shielding is used. This dose of x radiation produces marked inhibition of local fibroblast proliferation in peritoneal wounds, but has no effect on the reconstitution of the serosal mesothelium. From this it is argued that the newly formed mesothelium is derived principally from free-floating cells in the peritoneal exudate. (auth)

24630 HEPATIC GLYCOGEN AND SERUM GLUCOSE IN RATS WITH RADIATION DISEASE. Bankowski, Zbigniew; Bicz, Wlodzimierz; Biczowa, Barbara (Inst. of Experimental Pathology, Warsaw). Patol. Pol., 16: No. 3, 291-5(1965). (In Polish).

Wistar rats weighing 185 g were subjected to a 900-R, whole-body dose of 180-kv x rays, and 6 hr to 8 days later blood glucose levels and localization of glycogen in the liver were studied. Elevated blood glucose and hepatic glycogen levels were observed 6 hr and 3 days after irradiation. The mean blood glucose levels in controls and at 6 hr, 3, 6, and 8 days postirradiation were 44.9, 76.6, 91.9, 57.4, and 73.5 mg %; the corresponding hepatic glycogen levels were: 0.8, 3.6, 3.1, 0.7, and 0.7%. Thus, after 6 and 8 days, glucose and hepatic glycogen levels had returned to normal. Results of histochemical studies were in agreement with biochemical assays and indicated that storage of glycogen by cells of the peripheral portions of the hepatic lobules was impaired. Mechanisms that explain postirradiation changes in blood sugar and liver carbohydrate deposits are discussed. (BBB)

24631 FUTURE USES OF RADIOISOTOPES IN LARGE-ANIMAL RESEARCH. Lengemann, F. W. (New York State Veterinary Coll., Cornell Univ., Ithaca). J. Dairy Sci., 49: 1014-18(Aug. 1966).

Numerous aspects of applications of radioisotopes in veterinary research are discussed, with the emphasis on use of whole-body counting techniques and waste disposal. The problem of the high cost of large animals used for this purpose is also considered. One solution proposed for reducing animal costs is the establishment of special groups of mature animals used repeatedly for radioisotope experiments. Low levels of activity over long periods of time do not impair the metabolic function of animals, nor is there an accumulation of radioactivity that interferes with subsequent use with proper choice of radioisotope or the levels administered. In the future, it is suggested, γ-emitting isotopes will be used instead of β emitters. Little attenuation of a γ radiation takes place, compared to a β emitter, when the sample volume is increased. The larger the sample volume counted the less activity it is necessary to administer to the animal. Another procedure that will be prevalent is the preferential use of shortlived radioisotopes. Disposal of the radioactive waste will be simplified by allowing the radioactivity to decay away. In the future, waste disposal problems will be less acute because markedly reduced amounts of radioactivity will be administered as compared to levels used 10 yr ago. Part of the reason for this is the advent of crystal and liquid scintillation detectors that count large volumes of samples. Characteristics of various whole-body counter designs are described and illustrated, and some applications of neutron activation analysis are cited. It is concluded that the increased use of radiotracers in the future for large-animal research will depend upon reducing the problems of waste disposal and the high cost of experimental animals. (BBB)

24632 SUSCEPTIBILITY OF IRRADIATED INSECTS TO BACILLUS THURINGIENSIS INFECTION. Jafri, R. H. (Panjab Univ., Lahore, West Pakistan). pp 351-4 of Colloq. Intern. Pathol. Insects. Paris, 1962.

Experiments were performed on the susceptibility of x-irradiated Tribolium beetles to nonspecific bacterial toxin or to B. thuringiensis infection. Tribolium confusum and T. castaneum beetles were exposed to x-ray doses of 100, 50,000 or 90,000 R. T. confusum beetles were offered wheat flour (containing spores of B. thuringiensis) immediately after treatment 24 hr post irradiation, and on the seventh day after exposure to the x-ray dose. T. castaneum beetles, having latent infections of Farinocystis tribolii and Nosema whitei, were fed wheat flour (containing spores of B. thuringiensis) immediately after exposure. T. confusum beetles receiving nonspecific bacterial toxin immediately after exposure to 100, 50,000, or 90,000 R showed a gradually higher rate of mortality and mortality time was shortened as the dose was increased from 100 to 90,000 R. Mortality time of x-irradiated beetles receiving bacterial toxin on 7th day after irradiation showed a gradual rise in mortality and a sharp decrease in total mortality time as the dose was increased from 100 to 90,000 R. The comparative mortality pattern indicated not only decreased resistance of the irradiated hosts and higher susceptibility to B. thuringiensis toxin but also suggested the significant role of the time factor in administration of pathogen or toxin to the irradiated insects. The total mortality time of beetles manifesting latent infections of F. tribolii and N. whitei was shortened as the dose was increased from 100 to 90,000 R. These findings indicated that protozoan-infected beetles were more sensitive to radiation. The total mortality pattern of the irradiated beetles developing B. thuringiensis vegetative cells and of beetles manifesting no infection depended on the radiation dose. However, overall mortality time of beetles with B. thuringiensis vegetative cells was considerably decreased after exposure to different x-ray doses as compared to control nonirradiated beetles. These results suggested new means of biological and radiation control of stored grain pests and showed the practical importance of exploring the potentialities of bacterial toxins and of protozoan diseases in controlling nonirradiated and irradiated insects of economic importance. (BBB)

24633 THE MELANOSEBACEOUS FORMATION OF THE GOLDEN HAMSTER. V. REACTION TO LONG-TERM LOCAL IRRADIATION WITH X RAYS ASSOCIATED WITH APPLICATIONS OF METHYLCHOLANTHRENE. Oberman, B.; Riviere, M. R. (Institu de Recherches Scientifiques sur le Cancer, Villejuif, France). Bull. Ass. Franc. Etude Cancer, 52: 165-72 (Apr.-June 1965). (In French).

Hamsters (Mesocricetus auratus), 2 to 4 months old, were treated locally with x rays applied to one of the two so-called flank organs. The 225-kV x rays were given in doses of 600 R. Methylcholanthrene was applied to the same area twice weekly in concentrations of $^1/_{300}$ in acetone. In one group the x rays and the carcinogen were begun simultaneously and in the second x rays were begun one month after the carcinogen. The animals were sacrificed in 12 to 16 months and the melanosebaceous formation was examined histologically. Hyperplastic lesions were observed as well as spinocellular epitheliomas, but these tumors arose in the tissue adjacent to the melanosebaceous formation, in which no malignant changes were noted. The results show that this tissue is extremely resistant to carcinogenic agents. (BBB)

24634 EMBRYONIC MORTALITY RESULTING FROM GAMMA IRRADIATION. Morgan, Walter; Whitehead, Eugene (South Dakota Agricultural Experiment Station, Brookings). Proc. S. Dak. Acad. Sci., 43: 85-9(1964).

The lethal effect of varying doses of γ radiation on developing chick embryos was determined, and attempts to identify significant sex alterations and to observe the treated embryos and chicks for morphological abnormalities were made. The doses of ^{60}Co radiation were 200, 500, and 1000 R. The lower doses were not deleterious to the developing embryos. The 1000-R dose was lethal to all eggs that had been artificially incubated. Unincubated eggs irradiated with 1000 R took longer to hatch than did the nonirradiated eggs. Because hatchability of all other groups fell within an expected normal range, the mortality caused by 1000 R was examined to determine whether the exposure to γ rays caused immediate death, or death after a latent survival period. Twenty-eight of the 41 dead appeared to have succumbed at the time of treatment. However, at no age level was 1000 R immediately lethal to all treated embryos. The hatchability of the eggs in the control, 200-, and 500-R groups was above 90%. Baby chicks hatched from the control and experimental groups appeared healthy and normal except for one which hatched from an egg treated with 1000 R prior to incubation. That chick had aberrant digits and metatarsus on the left foot. (TSS)

24635 RADIOSENSITIZATION OF L CELLS BY PROFLAVINE. Fujiwara, Yoshisada; Kondo, Teruo (Kobe Medical Coll., Japan). Kobe J. Med. Sci., 11: 131-8(Sept. 1965).

The modifying action of proflavine on the cell-killing effect of

γ rays was investigated using L cells in culture. The sensitizing effect of low levels of proflavine on survival response of L cells to γ rays, using the mass-culture technique, was observed only when irradiation was performed on pretreated cells or on cells during treatment. Proflavine had no modifying effect on the cells which had survived γ radiation. Accordingly, the authors' proposed mechanism of radiosensitization, wherein specific chemicals potentiate the radiation effect by their selective binding with DNA and altering its priming function, was confirmed with proflavine. The biochemical implications of the mechanism of sensitization are discussed. (TSS)

24636 EFFECTS OF RADIATION THERAPY IN CHILDHOOD UPON GROWTH OF THE JAWS. Donohue, W. B.; Durand, C. A.; Baril, C. (Univ., Montreal). J. Can. Dent. Ass., 31: 1-6(Jan. 1965).

Stunting or total absence of tooth roots and micrognathia are reported in a 21-year-old male who received radiation therapy for a fibrosarcoma of the left maxillary sinus 14 years earlier. A concomitant example of idiopathic resorption is also described. The patient was given a total of 9000-R x radiation delivered at 200 kV over a nine-month period directed at both sides of the jaws. One year later he received a further 1400 R directed at the lymph nodes of the neck and submaxillary regions. The patient now presents pigmentation of the skin in the region that was irradiated. Cephalometric analysis indicates a diminution in the dimensions of the jaws similar to that noted in experimental studies. It is suggested that the under-development seen in cases of x irradiation during childhood is due to a reduction in the rate of bone formation, rather than a decrease in the size of the teeth. (TSS)

24637 RADIATION PNEUMONITIS AND FIBROSIS. Jacobs, Sydney (Tulane Univ. School of Medicine, New Orleans). J. La. Med. Soc., 117: 401-4(Dec. 1965).

The frequency of radiation pneumonitis and fibrosis was recorded in 282 women subjected to chest-wall radiation following breast amputation for carcinoma. Attention was centered on the persistent fibrosis which could be detected roentgenographically and classified by the following criteria: Grade I (lung markings increased, no more than 25% of the volume of a lung involved); Grade II (25–50% lung volume affected with little or no mediastinal shift); Grade III (more than 50% lung volume affected, pleuritis, moderate to marked mediastinal shifts). In 39 cases, lung sections at autopsy were studied in correlation with the last antemortem roentgenographic film. Grade III fibrosis was not found in any of these 282 women, and only 44 (17.7%) had roentgenographic evidence of lesser degrees of pulmonary fibrosis; of these, 38 were Grade I and 6 were Grade II. No patient had pleural effusion. The patient's ABO blood group, age at the time of irradiation, race, and presence or absence of vascular hypertension seemed not to influence resistance or susceptibility to radiation. It is likely that when a standardized amount of radiation is delivered to the thorax, variabilities of response are not great, suggesting that the amount of radiation received is the most important single factor in determining whether a given subject will receive significant radiation damage. (TSS)

24638 X-RAY INDUCED ABNORMALITIES AND RECOVERY IN HYMENOLEPIS MICROSTOMA. Tan, D. B.; Jones, Arthur W. (Univ. of Tennessee, Knoxville). Exp. Parasitol., 18: 355-73 (June 1966).

Seven-day old specimens of the cestode were subjected to single doses of 2500, 5000, and 7500 R of x rays in vitro. The worms were transplanted into mice, and after intervals of 2, 4, 6, 8, and 32 days, the hosts were sacrificed and the worms collected for study. Data, obtained on the morphology, number, and location of worms in each host, suggested that tissues of the neck region may be radioresistant near the scolex, but relatively radiosensitive in the region where proglottids are forming. Radiosensitivity extends throughout the regions where proglottids are maturing and is evidenced by abnormalities of organ and segment formation. Damage is proportional to dose. Apparently complete recovery occurs by the 32nd day after irradiation, the damaged strobila being replaced by a normal one. Both damage and recovery responses support the general view that radiation damage to growing organisms is largely a mitotic death effect. Cells which survive, in either an embryonic tissue, a bacterial population, or a cestode neck region, can mitotically replace the cells lost by radiation injury. (BBB)

24639 EFFECTS OF NEODYMIUM LASER RADIATION UPON THE HEADS OF DOGS. Earle, Kenneth M.; Garner, F. M.; Kraner, Keith L.; McKnight, William B.; Dearman, James R. (Armed Forces Inst. of Pathology, Washington, D. C.). Mil. Med., 132: 122-7(Feb. 1967).

Beagle dogs were exposed to single focused and unfocused shots of Nd laser radiation directed upon their shaved foreheads. The energy of the 4 shots on the target varied from 490 J focused over an area 2 mm in dia to 800 J unfocused over an area one cm in dia. The sequence of events was studied by high-speed movies (up to 700 frames/sec), by regular-speed movies, and by closed circuit television. On television the heads of the dogs appeared to move as a direct result of the shot, but high-speed photographs revealed that the movement came 0.1 sec after the shot, a time corresponding to reaction to startle or pain. The movement of the head occurred after the burning off period had completely cleared and could not have been due to any explosive, rocket-like, or other propulsive effect. The dogs appeared normal after the shots with no evidence of concussion. Autopsy 3 to 6 months later revealed superficial scarring of skin with failure of hair to re-grow at the sites of the initial burns. The skull, dura, and brain of each dog showed no evidence of damage from the laser radiation on gross or microscopic examination. (BBB)

24640 EFFECT OF IRRADIATION ON RENAL FUNCTION. Gup, A. K.; Schlegel, J. U.; Caldwell, T.; Schlosser, J. (Tulane Univ., New Orleans). J. Urol., 97: 36-9(Jan. 1967).

The effects on renal function of various low doses of local radiation, generally considered to be within the therapeutic range for man, were studied in dogs. Both kidneys were explanted subcutaneously. One kidney was then irradiated with 200-kV x rays, while the contralateral kidney served as a control. In 7 dogs, a dose of 200 rads was given every other day for 10 doses and in 6 dogs a dose of 200 rads was given every other day for 5 doses, in 2 dogs a single dose of 500 rads was given, and in 1 dog a single dose of 1000 rads was given. Blood urea nitrogen (BUN) and hematocrit were measured, and renograms were made at varying intervals. In 5 to 7 months following irradiation, differential renal function was evaluated by determination of glomerular filtration rate (GFR), renal plasma flow (RPF), urinary volume, urine sodium. The results indicated that local irradiation of 2000 rads cumulatively within 20 days, 1000 rads cumulatively within 12 days, 1000 rads acutely, and 500 rads acutely have a deleterious effect upon renal function in dogs, lowering GFR, RPF, and urine volume and causing BUN retention. At necropsy there was no significant difference in the gross appearance or weight between irradiated and nonirradiated kidneys. Microscopic examination revealed that the capsules of both the control and irradiated kidneys were thickened, apparently secondary to translocation. No changes which could be attributed to radiation damage were observed in the irradiated kidney. (BBB)

24641 THE EFFECT OF RADIATION ON THE LARYNX WITH PICTURES OF THESE EFFECTS. Alexander, Fred W.; Zack, Eugene Ann. Otol. Rhinol. Laryngol., 70: 118-27(Mar. 1961).

Five case reports are presented along with macro- and microscopic illustrations to demonstrate radiation effects on the larynx. Radionecrosis of the treated area, particularly of cartilage, was found in all cases. In one case a large esophageal fistula developed with breakdown of the wound and bleeding from the external carotid artery. Because of marked edema and swelling of the interior of the larynx, frequent direct laryngoscopies and biopsies are mandatory in following cases that have been irradiated for carcinoma of the larynx. The cases illustrated suggest that radiation in many squamous cell cancers of the larynx is ineffective. The persistence of radioinduced edema in the interior of the larynx, with the chronicity of the ulcerations and mucositis that prevails and the difficulty of examining these patients, indicate that surgery, not radiotherapy, should be used in advanced cases. The destructive effect of irradiation produces poor voice, marked dysphagia, and frequently makes tracheotomy necessary. An irradiated larynx follows a definite pattern of redness, edema, stenotic lymphedema, perichondritis, subperichondrial abscess, chondral necrosis, destruction of the laryngeal cartilages, fibrosis, cicatricial contraction with deformity of the lumen, and obliteration of the lumen with chronic ulceration and sloughing of the interior of the larynx. (TSS)

24642 THYROID CARCINOMA TEN YEARS AFTER SODIUM IODIDE (^{131}I) TREATMENT. Burke, Gerald; Levinson, Monte J.; Zitman, Irving H. (Michael Reese Hospital, Chicago). J. Amer. Med. Ass., 199: 247-51(Jan. 23, 1967).

Coexistence of thyroid carcinoma and hyperthyroidism is reported in a 37-yr-old woman previously (apparently successfully) treated with ^{131}I for thyrotoxicosis. An uncommon sequence of events occurred in this case and a possible relation between ^{131}I therapy and subsequent development of thyroid carcinoma existed. Since the reported frequency of thyroid carcinoma following ^{131}I therapy in the adult is well within the range of statistical coincidence, no basis for a cause and effect relation presently exists. A brief review is given of the literature concerning carcinoma of the thyroid following treatment of hyperthyroidism with radioiodine. In contrast to the numerous studies of thyroid tumors in patients irradiated during childhood and infancy, little information is available concerning radiation-induced thyroid carcinoma in persons exposed during adult life. Of 550 hyperthyroid patients which have

been treated with ^{131}I in the authors' lab since 1954, only 14 were less than 30 years of age, and the patient discussed here represents the sole instance of thyroid carcinoma following radioiodine therapy. (BBB)

24643 URETERAL STENOSIS FOLLOWING RADIOTHERAPY FOR CERVICAL CANCER. Masereeuw, J. (Univ., Amsterdam). Ned. Tijdschr. Geneesk., 110: 920-3(May 14, 1966). (In Dutch).

Urinary tract complications resulting from abdominal radiotherapy are reviewed, and 2 cases are described in which ureteral injury followed irradiation for cervical carcinoma. Ureteral stenosis caused by radiation treatment of cervical cancer is not rare. Hydronephrosis, pyonephrosis, urosepsis, and uremia may result. Ureteral stenosis may be caused by the tumor invading and encircling the ureteral wall, but fibrotic stenosis may be produced by irradiation, even if there is no recurrence of the tumor. This means that every possibility of relieving the stenosis should be investigated. Careful urologic postirradiation follow-up studies at regular intervals are required in all patients who have had radiotherapy for cervical carcinoma to detect ureteral stenosis, which is often insidious. Several methods of treatment are discussed. (BBB)

24644 CRITICAL STUDY OF THE CLINICAL RESULTS OF IMPLANTATIONS OF RADIOACTIVE ISOTOPES IN THE PITUITARY IN CERTAIN ENDOCRINE OR CANCEROUS DISEASES (62 CASES). Sedan, R.; Harter, M.; Simonin, R.; Paillas, J. E.; Vague, J. (Univ., Marseille, France). Neuro-Chir., 11: 241-52(May-June 1965). (In French).

Complications encountered in the course of irradiation of the pituitary by implanted ^{90}Y, ^{198}Au, and ^{192}Ir are reported with reference to 62 patients. Most patients were treated for metastatic breast or prostatic cancer, others for endocrine disorders. In 2 cases rhinorrhea developed, and in 2 other cases paralysis of ocular motor nerves occurred, which disappeared in several months. Visual disturbances, as a result of injury to the optic nerve, were not observed in any case. Diabetes insipidus was a frequent occurrence after ^{90}Y implantation, but often regressed. After implantation of ^{90}Y it was found necessary to compensate for hormonal deficiency by oral doses of cortisone (10 to 20 mg) and thyroid extract. Some patients complained of digestive disorders and nausea. Radioisotope doses given for various diseases, as well as the clinical effects of treatment, are also reported. (BBB)

24645 ENDOCRINOLOGICAL STUDY ON PROSTATIC CARCINOMA: EFFECTS OF ANTI-ANDROGENIC TREATMENT ON PITUITARY ACTH RESERVE FUNCTION. Anezaki, Mamoru (Niigata Univ., Japan). Nippon Hinyokika Gakkai Zasshi, 56: 696-714(July 1966). (In Japanese).

The ACTH and Metopirone tests were performed on 12 patients with prostatic carcinoma before and after various treatments to investigate changes in pituitary-adrenal function. Urinary 17-hydroxycorticosteroids (17-OHCS, Porter–Silber chromogens) were measured before and after ACTH and Metopirone administration. The treatments consisted of castration, estrogen administration, and pituitary x irradiation. Ten to 12 days after castration, urinary 17-OHCS levels showed a slight, but insignificant elevation. Results of ACTH and Metopirone tests showed no significant difference from the pretreatment values. Estrogen administration resulted in reduction of urinary 17-OHCS, and a marked reduction in pituitary ACTH reserve was observed. After pituitary irradiation with 4000 to 7500 R surface doses of 180-kv x rays, the urinary 17-OHCS levels remained within the control values. The results of ACTH and Metopirone tests showed no abnormality following irradiation with 4000 to 6000 R but a patient who received 7500 R irradiation showed a moderate reduction of pituitary ACTH reserve. After pituitary irradiation, no replacement corticoid therapy was required provided that the doses remained within 6000 R. After irradiation with more than 7500 R replacement therapy by corticosteroids was instituted on the basis of Metopirone tests. (BBB)

24646 OVARIAN LIGATURE AND X RAYS. Fels, E. (Instituto de Maternidad Ramon Sarda, Buenos Aires). Rev. Soc. Argent. Biol., 39: 305-7(Aug.-Nov. 1963). (In Spanish).

The tumorigenic effect of 2 procedures (x irradiation and ligature of the ovarian pedicle) shown to induce ovarian tumors were combined to determine whether an increased incidence of tumors resulted. Adult rats, weighing 120 to 150 g, underwent bilateral ovarian ligature and exposure to x rays in a single dose of 200 R over the entire body. There was no difference in the incidence of ovarian tumors in rats which had or had not received x rays after ovarian ligature. Thus, the incidence of tumors after the combined treatment, up to 440 days later, was 52%, whereas after ligature alone 50% of the animals developed tumors after a period of observation of up to 691 days. It is evident that a single dose of radiation did not augment the development of tumors. (BBB)

24647 GAMMA GLOBULIN AND ANTIBODY FORMATION IN VITRO. VI. EFFECT OF X IRRADIATION ON THE SECONDARY ANTIBODY RESPONSE IN VITRO. Stecher, Vera J.; Thorbecke, G. Jeanette (New York Univ., N. Y.). J. Exp. Med., 125: 33-44(Jan. 1, 1967).

The influence of x irradiation on the secondary antibody response in vitro was shown to be remarkably similar to its effect on the primary response in vivo. In studies in rabbits, when sensitized tissue was first irradiated and then reexposed to antigen (bovine serum, albumin, or diphtheria toxoid) the duration of the interval between irradiation and antigen addition determined the degree of inhibition of the secondary response obtained. A delay of 12 hr resulted in stronger inhibition than a delay of 6 hr, and an interval of 24 hr before reexposure to antigen caused complete suppression of antibody production to diphtheria toxoid and almost complete suppression when sheep red cells were used as the antigen. Induction of the secondary response in rabbit lymph node tissue in vitro followed by x irradiation revealed that immediate exposure to irradiation after antigen produced stronger inhibition of the subsequent response than irradiation on days 2 to 3. Irradiation on day 6 had no detectable effect. The effectiveness of the early irradiation is probably due to prevention of the proliferation of the antibody-forming cells. 5-Bromodeoxyuridine was found to be effective at similar time periods as x irradiation, whereas colchicine could still stop antibody formation when added late during the secondary response in vitro. (BBB)

24648 CONTROL OF PERITONEAL IMPLANTATION BY POSTOPERATIVE IRRADIATION. Stirling, C. T.; Schlosser, J. V.; Schmidt, F. L.; Cohn, I. Jr. (Louisiana State Univ., New Orleans). Bull. Soc. Int. Chir., 25: 308-12(May-June 1966).

Experiments were designed to test the effect of postoperative irradiation on peritoneal implantation following spillage of tumor cells into the peritoneal cavity, such as is believed to occur following surgery for intestinal carcinoma. The Brown–Pearce tumor was grown in the anterior chamber of the rabbit eye, then minced and injected intraperitoneally in other rabbits. The animals were irradiated the next day over the entire abdomen with a 400 R dose of 250-KV x rays. There were 18 pairs in which the irradiated animals had no tumor and the controls did. In only 5 pairs did the irradiated animals have tumor and the controls have no tumor. This result was statistically significant. Tumor was present in both animals in 20 pairs. Tumor did not grow in either animal in 6 pairs of rabbits. For the entire experiment, tumor was present in 25 irradiated animals and absent in 24 animals. In the control series, tumor was present in 38 animals and absent in only 11. This difference was also statistically significant. There was also a difference in the extent of peritoneal involvement with tumor. Massive peritoneal involvement occurred in 16 of the control animals and in only 5 of the irradiated animals. These results indicate that tumor implantation may be reduced by postoperative irradiation following surgery for carcinoma of the colon. No complications of irradiation were noted in any of the animals. Perhaps even greater reduction in tumor implantation may be possible by using a higher dosage or by giving the x ray in staggered doses. (BBB)

24649 EFFECT OF INSEMINATION OF LIQUID AND FROZEN BOVINE SEMEN AFTER IRRADIATION IN VITRO. Rowson, L. E. A.; Dott, H. M. (Univ. of Cambridge, Eng.). pp 552-6 of V Congresso Internazionale per la Riproduzione Animale e la Fecondazione Artificiale. Vol. 4. Trento, Sept. 6-13, 1964.

A total of 67 inseminations were carried out on maiden heifers with semen that had been x irradiated and held either at +2 or −79°C. Irradiation of bovine spermatozoa with 100 or 250 R had no obvious effect on the conception rate of liquid or frozen material. However, at 500 R no pregnancies were recorded after irradiation at +2°C and the number of pregnancies with frozen semen was reduced. No abnormalities were found in the fetuses that could not be accounted for by accidental damage to the membranes. One animal inseminated with semen irradiated with 500 R was slaughtered 209 days after insemination; the fetus appeared normal when examined. These results support the findings of other workers that a dose of 500 R applied to mammalian semen in vitro reduces the number of viable embryos that can be obtained by inseminating such spermatozoa. But many more inseminations will have to be carried out to establish this and to discover whether the protection against irradiation effects of cooling to −79°C is real or spurious. Reduction in the number of normal embryos obtained at 37 days after insemination with spermatozoa subjected to 500 R at the higher temperature could have resulted from a failure of fertilization or from the early death of the embryo. The latter might have resulted in an extension of the estrous cycle following insemination. (BBB)

24650 EFFECTS OF WHOLE-BODY X-IRRADIATION ON ELECTROSHOCK SEIZURE RESPONSES IN DEVELOPING RATS. Vernadakis, Antonia; Timiras, Paola S. (Univ. of California, Berkeley). Contract AT(11-1)-34. Amer. J. Physiol., 205: 177-80(July 1963).

Electroshock seizure responses were studied in irradiated rats between 8 and 55 days of age. They were exposed to 500 R of whole-body x irradiation 2 days postnatally. In maturing rats seizure patterns produced by brain stimulation with 50 mA current appeared in sequence: hyperkinesia, clonus, forelimb flexion, forelimb extension followed by hind limb flexion, and hind limb flexion followed by hind limb extension. In irradiated rats full flexor-extensor seizure pattern appeared in 50% of animals at 13 days of age, 3 days earlier than in controls. Extension was longer and flexion, clonus, and total seizure were shorter in irradiated than in controls. In both groups durations of clonus and total seizure were related inversely to durations of extension. Duration of flexion decreased and duration of extension increased up to 22nd day of age in all animals. This indicates increased neuronal activity as the brain matures. Also thresholds for minimal electroshock convulsions decreased up to 22nd day of age, further indicating increased brain activity with maturation. Thresholds were significantly lower in irradiated rats than in controls. (BBB)

24651 USE OF PARTIAL CELL IRRADIATION BY LASER MICROBEAM AS A MICROSURGICAL TOOL. Bessis, Marcel C. (Univ., Paris). Israel J. Med. Sci., 1: 1284-7(Nov. 1965).

This review surveys biological effects of laser irradiation, techniques used, laser radiation dosimetry, and precautions to personnel operating lasers. Effects of microbeams of uv radiation on cell components are also reviewed. To avoid possible damage to the eye due to an unplanned firing of a laser, 2 precautions should be taken: the eyepieces are fitted with special filters which absorb the wavelength of the laser radiation, and the effect of micropuncture is observed by means of a closed-circuit television system. The television vidicon tube must be protected by means of a screen, absorbing the wavelength of the laser radiation. Advantages of the use of the laser over the other methods of micropuncture are enumerated. Techniques for evaluation of laser effects which are described include the study of successive changes by time-lapse cinemicrography, examination under an electron microscope, evaluation of the metabolic disturbances in the cell, as revealed by autoradiographic study of the incorporation of labeled material, and histochemistry. Use of dyes to selectively destroy certain cell components with lasers is also described. (BBB)

24652 ALTERATION IN ODONTOGENESIS FOLLOWING X-IRRADIATION OF THE THYROID-PARATHYROID AREA OR THE ORAL REGION OF THE ALBINO RAT. Collett, William Keagy. Pittsburgh, Univ. of Pittsburgh, 1965. 102p.

Thesis.

This investigation measured alterations in the odontogenic response of the maxillary incisor teeth of the rat following short-term x irradiation at 900 R of the thyroid-parathyroid area, and to compare these alterations with those produced by radiation delivered solely to the anterior head, i.e., direct maxillary incisor irradiation. Alterations in odontogenic response were evaluated on the basis of radiographic and histologic changes in the maxillary incisors, changes in the incisor alkaline phosphatase content, and calcium distribution in various tissues of the animals. It was concluded that an odontogenic response of the maxillary incisors follows direct (head) irradiation of this structure as compared to the absence of an abscopal effect on tooth formation from irradiation of the thyroid-parathyroid area. The maxillary incisor teeth of the head-irradiated animals develop radiation-induced lesions which are visible clinically, radiographically and histologically. These lesions are not produced by irradiation of the thyroid-parathyroid area. Although the calcium mobilization patterns of the thyroid-parathyroid irradiated animals differ from the controls, they are similar to those found in the head-irradiated animals. The results suggest that radiation effect on the thyroid-parathyroid area is not an important factor in the radiation-induced dental syndrome. (TSS)

24653 SURGICAL APPLICATIONS OF LASER. McGuff, Paul Edward. Springfield, Ill., Charles C Thomas Publisher, 1966. 210p. $10.50.

A brief historical background of cancer research, a succinct discussion of laser theory, and the outlines and results of experimental studies using laser are presented. The experimental studies consisted primarily of the effects of laser radiation on different types of malignant tumors in Syrian hamsters; photographic illustrations are presented in the text. Other areas discussed and reviewed were the effects of laser energy on malignant human tumors; histochemical studies on the pathological appearance of laser malignant tumors and other tissues; concepts and hypotheses derived from experimental studies and observations; the present status of laser applications: the effects of laser radiation on blood vessels, bone, enzymes, heart and other internal organs, nervous system, skin, Spirogyra, and tissue culture cells and their subcellular components; as well as the uses of laser in eye surgery, other forms of surgery, spectroscopic analysis, and tumor therapy. (B.H.S.)

24654 TISSUE TRANSPLANTATION IMMUNITY IN THE ADULT NEWT, DIEMICTYLUS VIRIDESCENS. Cohen, Nicholas. Rochester, N. Y., Univ. of Rochester, 1966. 295p.

Thesis.

Skin allograft rejection was studied in field collected populations of the adult salamander, Diemictylus viridescens. Following allogeneic transplantation of dorsal pigmented skin there was a long latent period of about 16 days (at 23 ± 0.5°C) when such grafts were indistinguishable from autografts. During this period, autografts and allografts were vascularized from 10 to 11 days (on the average) after transplantation, apparently by end to end anastomoses of graft and host vessels. Vascularization was usually preceded by an initial dilation of the grafts' vessels. An approximate five fold increase in the thickness of the dermal collagen of all grafts was noted during this phase as well as during the rejection phase. Graft rejection at 23 ± 0.5°C was manifested externally by: secondary vessel dilation (about 17 days); hemostasis (about 20 days); hemorrhage (about 23 days); and eventual melanophore death (from 30 to 40 days). All these events were somewhat variable with respect to time of onset, intensity, and duration. Histologically, all these morphological changes that distinguished an allograft from an autograft were paralleled by: an increasing infiltration of small lymphocytes without tissue destruction (secondary vasodilation) and a stronger infiltration of lymphocytes concomitant with glandular death (hemostasis, hemorrhaging, and melanophore death). Although this pattern of rejection was the norm, several examples of long-term graft survival healthy grafts with no lymphocytic infiltration after 25 days) were encountered. That this chronic rejection of skin allografts was immunologically mediated was confirmed by a vigorous second-set reaction when second-set grafts were transplanted 28 days after first-set grafts from the same donor. Contrary to the findings in other species, second-set grafts were vascularized prior to their accelerated destruction in about 58% of the cases studied. The rejection of the second-set transplants followed the pattern of rejection of the first-set transplants with respect to the severity of the rejection response. Second-set transplants grafted 10 days after first-set grafts were not rejected anamnestically. Rather, such grafts survived for a few days longer than the first-set grafts transplanted to the same host (in terms of absolute number of days following their respective transplantation). The site of transplantation (flank and throat) and the size of the grafts (from 2 mm^2 to about 6 mm^2) did not appear to alter the rejection pattern or the times at which certain events occurred. The rejection of grafts from donors of different sexes transplanted to the same or to different hosts of both sexes did not reveal any sexual dimorphic response as was claimed by other authors. It was demonstrated that graded doses of x radiation from 500 R to 3000 R inhibited allograft destruction for at least as long as the survival time of the hosts (up to 35 days). The effects of various temperatures on allograft rejection were also examined. There was no difference in the mean survival times of grafts maintained at 30°C and 23°C. At 20°C, however, hemostasis and hemorrhaging were significantly delayed by a factor of 1.6 and 1.7 times, respectively, when compared with the time these events occurred at 23°C. At 10 to 15°C, no vascular indications of rejection were evident for 191 days after transplantation. Lymphocytes, however, were apparent in very weak concentration in tissues of some of the grafts and very localized destruction of some melanophores were noted. Two grafts maintained first at 10 to 15°C for 155 days and then transferred to 20°C, were completely destroyed within 36 days after their transferral. This destruction was more rapid than the destruction of grafts initially maintained at 20°C. (Dissertation Abstr.)

24655 VLIYANIE RENTGENOBLUCHENIYA NA ELEKTRICHESKIE PROTSESSY RAZLICHNYKH STRUKTUR GOLOVNOGO MOZGA. (Effect of X-Ray Irradiation on the Electrical Processes of Various Parts of the Brain). Gadzhieva, N. A. Baku, Publishing House of the Academy of Sciences, Azerbaidzhan SSR, 1965. 114p.

The literature on the effects of ionizing radiation of various parts of the animal brain is reviewed. Latent effects of x radiation on structure and function of the brain are discussed. Electrical activity was observed in the brains of x-irradiated animals during different types of stimulation. Bibliographies are included. (H.G.D.)

Radiation Effects on Plants

Refer also to abstracts 24342, 24358, 24378, 24382–24385, and 24391–24393.

24656 SENSITIVITY OF GERMINATING RICE SEEDS TO IRRADIATION IN RELATION TO THE GROWTH OF SEEDLINGS. Lo, Tsung-lo; Fang, I-hsiung (Inst. of Plant Physiology, Chinese Academy of Sciences). Shih Yen Sheng Wu Hsueh Pao, 7: No. 1-2, 123-31(Dec. 1960). (In Chinese).

Germinating rice seeds were treated with 10 and 20 kR-doses of x radiation. Seeds irradiated with the 20 kR-dose sprouted; however, at 12 days postirradiation almost all sprouts perished. A 10 kR-dose (LD_{50}) was found to be semi-lethal; death occurred within 10 to 15 days. Seeds were soaked in water at 30°C for 12 to 96 hours and exposed to a 10 kR radiation dose. The 24 to 72 hour soaked seeds were more radiosensitive than the seeds soaked in water for 12 or 96 hours; therefore, rice seed radiosensitivity was shown not to be totally dependent on water content. Rice seeds were soaked in solutions of NaCl or sugar (0.5 to 3.0%) and exposed to 10 kR of radiation. Soaking in NaCl increased stability toward radiation and soaking in sugar decreased stability toward radiation. It was concluded that the most radiosensitive stages were during the periods of intensive germinating activity and generally during the intensive growth period. The positive reaction of NaCl decreasing the radiosensitivity was attributed to the suppression of seed germination. (TSS)

24657 X-RAY INDUCED VARIABILITY FOR PROTEIN CONTENT IN BREAD WHEAT. Banerjee, S. K.; Swaminathan, M. S. (Indian Agricultural Research Inst., New Delhi). Indian J. Genet. Plant Breed., 26: 203-9(July 1966).

The extent of variation in protein content induced by x rays in the bread wheat variety N.P. 824 was examined. Dry seeds (12% moisture content) were irradiated with 50 KV x rays at 2000 R/min for total doses of 16 and 22 KR. There was much variation in protein content of grain in the treated population in the M_1 generation. The mean protein percentage in the control material was 12.26, whereas the minimum and maximum protein contents in the treated material were 11.11% and 14.36% respectively. In the 5 samples treated with 16 KR, 3 lines showed a decrease in protein, one line was equal to the control, and one line showed a rise over the control. Variance in the control population was 0.013, whereas in the 16-KR and 22-KR groups it was 1.33 and 0.86 respectively. Seeds from individual M_1 plants were grown to give the M_2 generation. Except for one line derived from the 16-KR treatment, a rise in grain protein content over the control was noted. The highest protein percentage recorded was 13.74 and the lowest 10.76, whereas the mean protein percentage in the control was 10.89. The variances in the control, 16-KR, and 22-KR populations were 0.021, 0.25, and 0.58 respectively. In the M_3 generation the mean protein percentage in grain from control plants was 9.91, and 2 treated lines maintained a higher protein percentage over the control (10.04 and 10.30%). Thus, after 3 years' selection, 2 high protein lines were isolated, of which one showed a significant rise in protein content over the control. (BBB)

24658 OBSERVATIONS WITH THE PHASE CONTRAST MICROSCOPE ON THE EPIDERMAL CELL OF ALLIUM CEPA L. SCALES IRRADIATED WITH X-RAYS. Okyar, Sehavet (Univ. of Istanbul). Istanbul Univ. Fen Fak. Mecm., Seri B, 30: 1-29(1965).

The upper epidermis of onion bulb scales was irradiated with the soft x rays at doses between 25,000 and 600,000 R. Irradiation at a dose of 300,000 R was considered as a critical level between sublethal and lethal doses. Phase contrast microscopy revealed that the upper epidermal cell contains cytoplasmic vesicles that are continuously motile. The first observable effect on the living onion epidermal cell was a decrease of the plasma streaming speed. Effects could also be observed on the proplastids and the chondriosomes: a rounding-up, swelling, and finally vacuolization (after irradiations with higher doses) were seen. Damage to the nucleus by x rays was clearly evident from changes in the grains of chromatin; they became larger and darker. At this time the cytoplasm, as seen by the phase contrast microscope, showed no damage. The volume of the nucleus became smaller, and the nuclear sap swelled and was ejected from the nucleus through the nuclear membrane as large vacuoles. At this time the cytoplasm also showed vacuolization, and later a fine granulation. In addition, damage to the cell wall could be seen as a splitting or an undulation between adjacent cell walls. Because of their increased double refraction they were easily seen by dark field microscopy. The sphaerosomes were the most stable elements in the onion cell, and showed no morphologic changes. Only sphaerosomes of badly damaged cells, irradiated with a high x-ray dose, showed slight form changes; they seemed smaller and slightly oval. The resistance of the cytoplasm to external influence (plasmolysis and deplasmolysis) decreased after irradiation when a sublethal dose was given. The protoplast of cells irradiated with a sublethal dose, even though their chondriome and nuclei were but slightly injured, had a shorter survival time (in comparison to nonirradiated preparations after plasmolytic treatment). After irradiation with 400,000 and 600,000 R the appearance of the lethally-damaged cells differed from that after lower x-ray doses. The final stages were reached so fast that the various morphological alterations could not be followed stepwise with the microscope. (BBB)

24659 CHIMERAS IN MUTATION BREEDING. Broertjes, C. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands). Mededel. Dir. Tuinbouw, 24: 291-5 (1961). (In Dutch).

The use of radiation in chimera production, and in unmasking them, for plant breeding is discussed. Chimeras are very common among asexually propagated plants; irradiation generally produces chimeras because mutation is a unicellular event and because of the complex nature of the shoot meristem. Both the natural and radioinduced chimeras can be altered by using ionizing radiation for the induction of doubling or perforation of cell layers. The resulting uncovering and rearrangement of genetically different tissues can, in theory, be done in every plant, thus bringing the spontaneous or artificial mutation into the best position. This requires a careful determination of the optimal dose; too low a dose has no effect, whereas too high a dose kills too many cells and eventually the whole plant. (BBB)

24660 EFFECTS OF CHRONIC GAMMA RADIATION ON SEED PRODUCTION IN AN OAK FOREST. Stairs, G. R. (State Univ. of New York, Syracuse). Advan. Frontiers Plant Sci., 9: 207-16(1964).

Radiosensitivity of seed production was investigated in Quercus trees growing under conditions of chronic ^{137}Cs γ radiation. Evaluation of radiation damage was made from observations on floral structures, embryogenesis, and the growth of progeny obtained from seed. Embryo enlargement was completely inhibited at an early stage on trees exposed to 45 R/day; at radiation intensities above 45 R/day both vegetative and reproductive development were completely suppressed. At an exposure of 25 R/day seed was obtained from parent trees that were irradiated for 10 months. The seed produced at this level was low in germinative capacity and few seedlings survived. At 10 R/day, after 10 months' exposure, trees produced seed which did not differ significantly in embryo content or germinative ability from that of the controls. The frequency of aberrations in embryo development increased at the higher levels of radiation, but they were sporadic in appearance. Probably, radiation-damaged acorns abscised from the tree and thus escaped detection. The ability of an oak forest to produce seed under conditions of chronic radiation followed closely the survival curve for vegetative growth. The study also indicated that the tolerance of seed development to chronic radiation may be more closely related to exposure rates during particular cell cycles than to overall accumulated exposure. No significant difference was observed between the 2 species studied: Q. ilicifolia and Q. coccinea. (BBB)

24661 MORPHOLOGICAL AND CYTOLOGICAL RESPONSE OF PEARL MILLET, PENNISETUM TYPHOIDES, TO THERMAL NEUTRON AND ETHYL METHANE SULFONATE SEED TREATMENTS. Burton, Glenn W.; Powell, Jerrel B. (Dept. of Agriculture, Tifton, Ga. Univ. of Georgia, Tifton). Crop Sci., 6: 180-2(Mar.-Apr. 1966).

Three dosages each of thermal neutrons (TN) and ethyl methane sulfonate (EMS) were applied to 10 pearl-millet inbreds evaluated in replicated plots in the field. Both mutagens delayed seedling emergence and days to maturity, and reduced seedling height, plant height, leaves per culm, and selfed and sibbed seed set. EMS reduced percent emergence and plants per plot to reach maturity. This extra space allowed EMS-treated survivors to produce more culms and yield more. Two-thirds of the 56 sectorial mutants came from TN-treated seed. Significant inbred × treatment interactions were obtained for 5 of 13 characters studied. Frequencies of chlorophyll-deficient seedlings from selfed seed of all plants indicated that the 90-minute TN treatment and 0.4% EMS soak for 4 hours increased the average mutation frequency most (some 5 fold). Mutation frequency in inbreds varied greatly. The most effective EMS treatment induced over 8 times as many mutants in 1 inbred as in another. The 90-minute TN treatment produced 4 times as many plants (28%) with chromosome interchanges as the heaviest EMS treatment. (auth)

24662 POSSIBILITIES OF USING IONIZING RADIATIONS FOR THE PRODUCTION OF HEREDITARY VARIATIONS WHICH CAN BE UTILIZED IN CULTIVATED PLANTS OF TROPICAL REGIONS OF AFRICA. Bilquez, A. F. (Office de la Recherche Scientifique et Technique, Paris). Oleagineux, 17: 540-6(June 1962). (In French).

Use of radiation in the induction of economically valuable mutants in peanuts and other crops of interest in tropical countries is reported. One variety of peanuts studied (48.115)

was shown to be 1.7 times more sensitive to x rays than another variety (28.204). Results are also shown for the lethal effects of x radiation on seeds of Crepis zacintha irradiated at 2 different moisture levels (5 and 15%). Lethality was lower when germination was carried out at 28° as compared with 21 or 13°C. The detection and isolation of radioinduced mutants are discussed in relation to plants which multiply by vegetative means on the one hand and those that reproduce sexually on the other. Conditions are defined for irradiation of these 2 types of plants. Mutant forms of peanuts obtained by the techniques described are illustrated. (BBB)

24663 MUTATIONS INDUCED IN GROUNDNUT BY X RAYS. Patil, S. H. (Atomic Energy Establishment, Trombay, India). Indian J. Genet. Plant Breed., 26A: 334-48(1966).

Experiments on peanuts with x radiation yielded 28 mutations affecting almost every feature of the plant. Over 60% of the mutants appeared in X_2 and X_3 generations. However, economically important mutants such as tertiary branching and large-pod mutants could be isolated only after X_3. More than 40% of the isolated mutants belonged to one of the cytological X_1 variants. They included among others, mutations for chromosome number, e.g., trisomics and tetrasomics. Consistent selection for increased kernel weight resulted in the isolation of a large-pod mutant in X_5. This and the tertiary branching mutant having increased pod setting were the only economically useful variants; the remainder were apparently inferior. A multicarpellary mutant, with pegs transformed to branches, was isolated for the first time in the peanut and was found to be under genetic control. (BBB)

24664 STUDIES ON RADIOSENSITIVITY OF FOREST TREES. IV. MINERAL CONTENTS IN LEAVES OF TREES GROWING UNDER CHRONIC GAMMA IRRADIATION IN A GAMMA FIELD. Oba, Kihachiro (Inst. of Radiation Breeding, Omiya, Japan); Furukawa, Tadashi. Nippon Ringaku Kaishi, 48: 163-75(Apr. 1966). (In Japanese).

The contents of nitrogen, phosphorus, potassium, and calcium, as percentage of the dry weight, in leaves of trees growing under chronic gamma irradiation in a gamma field were investigated in relation to the dose rate, the height increment, and the induction of chlorophyll somatic mutations; (1) The dry matter contents in leaves decreased in a dose rate range where severe growth inhibition was produced. (2) The contents of N, P, and K in leaves frequently increased following intensification in dose rate in various tree species while contents of Ca generally decreased. The results obtained in July showed the above-mentioned change more frequently than those in October to December. (3) The contents varied more frequently in conifers than those in broad leaved trees, and the contents of N, P, Ca in the former and those of K, Ca in the latter showed the change more often. In Populus and Paulownia species there was less change in the content of the elements, and in Pinus and Paulownia species there was little change in the Ca contents. During 1963 and 1964, the optimum dose rate for the induction of the chlorophyll somatic mutations in Cryptomeria japonica D. Don, Kuma-Sugi, was estimated as 7 to 10 r/day, and in this dose rate range, annual height increments were about $\frac{1}{10}$ of the control. Moreover, the contents of the elements began to deviate significantly in this range from those of the controls. The annual height increment and the breast height diameter of other tree species decreased with higher dose rate. (NSA of Japan)

24665 RADIATION STUDIES ON JAPONICA-INDICA RICE HYBRIDS. Joshua, D. C.; Rao, N. S.; Gopal Ayengar, A. R. (Atomic Energy Establishment, Trombay, India). Indian J. Genet. Plant Breed., 26A: 298-311(1966).

Seeds of 2 rice varieties, Norin 6 and Ptb. 10, representing the japonica and indica subspecies of Oryza sativa respectively and their hybrids were irradiated with 10, 20, and 30 kR at a dose rate of 138,000 rads/hr, with ^{60}Co source. The irradiated seeds were sown in nursery beds within 30 min after irradiation. Meiosis in the controls in both parents was normal. Cytological studies of the unirradiated hybrids showed differential segments, heteromorphic bivalents and, with very low frequency, quadrivalents, inversions, and laggards indicating structural differentiation. The frequencies of interchanges in M_1 and semisterile plants and mutants in M_2 were lower in Norin 6 than in Ptb. 10 varieties and might be due to the pattern of diplontic selection operating in Norin 6. The mutation rate was high even in the unirradiated hybrids. There was a disproportionate increase of tigrina mutants in the irradiated as well as in the untreated hybird. The occurrence of albina and tigrina mutants in the progeny of untreated hybrids and deviations from the expected spectra with irradiation may result if the linkage groups are different in japonica and indica rices. The semi-sterility in the hybrids appeared to be governed by duplicate/deficient segments arising from a single interchange and small deficiencies at different loci in their homologs. (BBB)

24666 SELECTION OF TETRAPLOID FORMS OF LUPINUS ANGUSTIFOLIUS AFTER X IRRADIATION AND RESULTS OF COMPARATIVE STUDIES WITH THE DIPLOID PARENTAL STRAINS. Zachow, Fritz (Institut fuer Pflanzenzuechtung, Berlin, Guelzow-Guestrow, Ger.). Zuechter, 36: 256-63(1966). (In German).

A cytologic study was made of 19 radioinduced mutant plants representing 8 mutant strains: Guelzower Rote Bittere no. 2310 and 2254, 2 albina mutants, Guelzower strain 57, and 2 crosses between these strains. After x irradiation these mutants with broader leaves were selected from different X_2 generations of Lupinus angustifolius. The pollen grains deviated greatly from their normal form and it was evident that they were tetraploids. Comparative studies with the parental forms and counts of chromosomes demonstrated 7 of the mutant strains to be tetraploid. Measurements of plant height and counts of seed setting permitted estimations of the yield capacity of the tetraploids. (BBB)

24667 IDENTIFICATION AND MODE OF ACTION OF A COMPONENT OF POSITIVELY-IONIZED AIR CAUSING ENHANCED GROWTH IN PLANTS. Smith, Richard F.; Fuller, Wallace H. (Univ. of Arizona, Tucson). Plant Physiol., 36: 747-51(Nov. 1961).

The effect of positive and negative ions produced by tritium radiation on the common blue-green algae and oats was studied. Exposure of Microcoleus vaginatus to positively ionized air resulted in increased migration and growth effect, dependent upon the presence of positively ionized carbon dioxide, could be duplicated by adding minute amounts of indoleacetic acid. Positive air ions cause increased growth of oat coleoptiles and release added indoleacetic acid from corn coleoptiles. The hypothesis is advanced that positively ionized air causes increased growth in plants by releasing endogenous bound indoleacetic acid. (BBB)

24668 ON THE RIBONUCLEIC ACID METABOLISM OF DATURA TISSUES AFTER AN X IRRADIATION. Brucker, W.; Rohde, H. G. (Ernst-Moritz-Arndt-Univ., Greifswald, Ger.). Ber. Deut. Bot. Ges., 70: 134-42(1966). (In German).

A crown gall tumor of Datura innoxia cultured in vitro was irradiated with 200-kV x rays at a dose rate of 195 R/min. The total dose administered was 3 kR. The subsequent growth of the tissues studied was reduced by about 60% over a period of 14 days after irradiation. The irradiation dose administered had no effect on the absolute amounts or composition of nucleotides in the RNA. The incorporation of ^{32}P in the several nucleotides of the RNA was reduced by about 35% within 8 hr after the irradiation, as compared to unirradiated controls. Within 24 to 48 hr after irradiation and addition of ^{32}P to the nutrient medium, the various nucleotides were differently affected. Incorporation of ^{32}P into adenylic acid was essentially unchanged. There was an inhibition of about 25% in the metabolism of cytidylic acid and guanylic acid. In comparison to unirradiated controls, ^{32}P incorporation in uridylic acid was increased by about 60%. (BBB)

24669 SOMATIC ABERRATIONS IN SOLANUM TUBEROSUM INDUCED BY ETHYL METHANE SULFONATE AND X IRRADIATION. Umaerus, Magnhild (Swedish Seed Association, Svaloef). Z. Pflanzenzuecht., 55: 238-45(May 1966).

The use of ethyl methanesulfonate (EMS) for induction of somatic changes in potatoes and a comparison of its effects with those of x irradiation were studied. Observations were made on the first, second, third, and fourth vegetative generations after treatment (vM_1, vM_2, vM_3, vM_4). In all treatments growth was retarded during the first week, and retardation was stronger after EMS treatment than in x-irradiated material. Normal tuber-producing plants developed in about half the plants having received 4000 R, but in only one plant having received 8000 R. Varietal differences in sensitivity to x irradiation were found. The size of tubers was decreased after EMS treatment but rate of development was more normal than after x irradiation. Aberrations noted in vM_1 were leaf deformations, chlorophyll-free leaf sections, and changes in anthocyanin coloration of the stem. Many plants, especially after x irradiation, were weak and/or developed swellings on the stems. In vM_2 one plant with a change of flower color was observed. Some aberrations found in vM_2 were verified in vM_3, and some of the clones were observed also in vM_4. An increased tendency to discoloration of the raw potato was found in two cases after x irradiation. One clone had few, thick stems, broad, round leaves, the plant height was decreased, the plant was erect and rigid, it was late in flowering and tuber formation and very late in sprouting. A second progeny, besides a tendency to discoloration, had a pronounced tendency to accumulate reducing sugar. The kind of aberrations induced by EMS in some cases did not seem to differ from those induced by x irradiation or those occurring spontaneously. (TSS)

24670 GENETIC CHANGES INDUCED BY SEMI-ACUTE γ-IRRADIATION OF POLLEN MOTHER CELLS IN LARIX LEPTO-

LEPIS (SIEB ET ZUCC.) GORD. Eriksson, Goesta; Ekberg, Inger; Ehrenberg, Lars; Bevilacqua, Branka (Royal Coll. of Forestry, Stockholm). Hereditas, 55: 213-26(1966).

The usefulness of waxy mutants as an indicator system in mutation research on forest trees is pointed out. Pollen grains resembling the waxy pollen grains in maize and barley were induced after 24-hr γ irradiation (^{137}Cs) of the pollen mother cells (PMC) in a clone of Larix leptolepis. The dose range used was 45 to 500 rads. The dose response curves for induction of waxy pollen grains and of pollen sterility were found to be sigmoidal, whereas the percentage of aberrant divisions seemed to increase more linearly with the dose. Doses in the range of 90 to 500 rads gave appreciably higher rates of giant (possibly diploid) pollen grains than was found in the control material. In the cytological examination of the irradiated materials several types of chromosomal aberrations, such as bridges, fragments, micronuclei, ring chromosomes, and lagging chromosomes, were detected. Often only 11 of the 12 bivalents were oriented in the equatorial plane during metaphase I in irradiated PMC. After 500-rads irradiation a high degree of fragmentation was observed. Besides fragmentation, the formation of micronuclei was also frequent. (BBB)

24671 MUTATION BREEDING OF CHRYSANTHEMUMS. Broertjes, C. (EURATOM-ITAL, Wageningen, Netherlands). Euphytica, 15: 156-62(1966).

Rooted cuttings of the pot-grown chrysanthemum variety Hortensien Rose were irradiated with x rays, fast neutrons, thermal neutrons, and electrons. The plants were topped to stimulate sideshoot formation, often resulting in complete periclinal chimeras (sports). Electrons were ineffective, producing only 6 to 10% mutated plants. The optimum dose x rays was 1500 rad. Both fast and thermal neutrons markedly increased mutation frequency, the optimum dose resulting in both cases in 28% of mutated plants. The mutation spectra, e.g., the type of mutations induced, showed variations after the various treatments. But the number of plants irradiated, as well as the number of mutations induced, did not indicate that a certain treatment results in a specific mutation spectrum, although there was a tendency towards greater variability after neutron irradiation. The mutation spectrum as well as the frequency greatly depended on the genetic constitution of the treated material. Irradiation of the pink-flowering Hortensien Rose variety, with the maximum number of dominant genes for flower color, resulted in a great number of different flower colors, as was expected, as well as many mutations of flower shape and size. Other pink-flowering varieties showed a similar spectrum, although in some cases the frequency was low or even zero. Chrysanthemum varieties with other flower colors showed a lower mutation rate, most of the flower color mutations being based on a lower number of dominant genes. (BBB)

24672 EFFECTS OF RADIATION ON THE SUSCEPTIBILITY OF WHEAT SEEDLINGS TO LEAF RUST. Katsuya, Keizo; Ono, Yukio (National Inst. of Genetics, Misima, Japan). Nippon Shokubutsu Byori Gakkaiho, 26: No. 4, 147-52(1961). (In Japanese).

Using Triticum spelta, T. timopheevi, T. vulgare, and Oryza sativa, seedlings at the 2-leaf stage were irradiated by x rays or by γ rays at 10, 30, 50, and 70 KR. The seedlings were inoculated 1 and 7 days after irradiation by spraying with an aqueous uredospore suspension (Puccinia triticina 21 B), and the effects of radiation on the susceptibility to the leaf rust were observed. The first and second leaves were sampled, and the amounts of amino nitrogen and reducing sugar were measured. Effects of irradiation on leaf characters, namely stomata size, internal structure, and viability, and on sporulation of the fungus on the leaves were examined. Rust susceptibility of the irradiated plants (T. spelta and T. vulgare) was increased, as compared with the nonirradiated plants. In T. timopheevi which was inoculated 7 days after irradiation, the third leaf was susceptible, while the first and second leaves of the same plants were resistant. The irradiated rice plants remained immune. In T. timopheevi, the amino nitrogen level was higher in the seedlings 1 day after irradiation as compared with that of the nonirradiated seedlings, but was lower 7 days after irradiation. The amount of reducing sugar increased in seedlings 1 and 7 days after irradiation, in comparison with the nonirradiated seedlings. Stomata size and internal structure of the irradiated plants (T. spelta and T. vulgare) did not change as compared with the nonirradiated plants. Effects of irradiation on the viability of leaves were tested. When the growing point suffered radiation damage, the already developed leaves remained fresh longer than those of the nonirradiated plants. The uredosori of the leaf rust produced on irradiated T. vulgare were larger than on normal plants. (BBB)

24673 ORGANIZATION AND CO-ORDINATION OF MUTATION BREEDING RESEARCH IN THE NETHERLANDS. Broertjes, C. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands). Mededel. Landbouwhogesch. Opzoekingssta. Staat Gent, 30: 967-75(1965).

Research supported by Euratom in breeding of radioinduced mutant plants of economic interest is reviewed. Problems encountered in the use of radiation in various types of plants are discussed. With cross-pollinating plants, which are extremely heterozygous, usually repeated irradiation is needed for attempts to increase the variability. Then selection is applied. Vegetatively propagated plants are usually fairly heterozygous, so that a mutation can often be identified in the irradiated material. Favorable mutations can be maintained by a suitable vegetative propagation method. Diplontic selection, viz, competition between normal and mutated cells, is important in vegetatively propagated plants, but mutated cells can be afforded advantages when special techniques are used. The vegetative apices and other reproductive organs should usually be irradiated in the earliest possible stage, if possible in the unicellular stage (Saintpaulia, Begonia). This improves both the mutation spectrum and the mutation frequency. Starting from good cultivars of vegetatively propagated plants obtained by conventional breeding, it is possible to alter one or more characters by means of irradiation. Statistically, such a new genotype cannot be obtained by crossing. Hence there is a good chance that radioinduced mutation breeding may be time-saving in such crops as fruit, potato, and ornamental plants. Attractive sterile cultivars (triploid tulips, roses, species hybrids), for which conventional breeding methods are not applicable, can still be made accessible for selection by mutation induction and the resultant variability. Chimeras in which spontaneous mutations may be concealed can be readily unmasked by means of irradiation. (BBB)

24674 ISPOL'ZOVANIE IONIZIRUYUSHCHIKH IZLUCHENII V RASTENIEVODSTVE. (Use of Ionizing Radiation in Plant Cultivation). Batygin, N. F.; Savin, V. N. Leningrad, Izdatel'stvo Kolos, 1966. 124p.

A brief review is given of the use of ionizing radiation in plant cultivation. The effects of radiation on productivity and plant development and radiosensitivity of various agricultural species are discussed. Development and yield of plants developing from irradiated seed are analyzed. Extensive bibliographies are included. (R.V.J.)

Radiation Effects on Microorganisms

Refer also to abstracts 24310, 24320, 24365, 24460, 24481, 24483, and 24693.

24675 RECOVERY FROM ULTRAVIOLET- AND ALKYLATING-AGENT-INDUCED DAMAGE IN BACILLUS SUBTILIS. Strauss, B.; Reiter, H.; Searashi, T. (Univ. of Chicago). Radiat. Res., Suppl. No. 6, 201-11(1966).

The conclusion that there is recovery from methyl methone sulfonate (MMS) induced damage is supported both by the isolation of an MMS-sensitive strain, mms^-, and by the transformation experiments. Recovery from MMS is distinct from recovery from uv in the sense that a uvr^- cell is able to recover from MMS-induced damage. We suppose that the reason that recovery from MMS can be observed with mms^+ cells as assay organisms for transformation is that, in the course of extraction, any alkylated DNA is irreparably degraded by contact with the specific nuclease described above. If Wahl's conclusion that MMS inactivation of transforming DNA is due to single-strand breakage is correct, then the MMS-sensitive mutants may be unable to repair single-strand breaks. However, other explanations also account for the properties of such mutants. The repair of MMS-induced damage observed in these experiments occurs in the presence of minimal amounts of thymine. There is therefore no evidence which shows any requirement for thymine in the repair of MMS damage, an understandable finding if the repair is of single-strand breaks. (auth)

24676 THYMINELESS RADIOSENSITIZATION IN ESCHERICHIA COLI. Kaplan, Henry S. (Stanford Univ., Calif.). Radiat. Res., Suppl. No. 6, 185-93(1966).

A multiple auxotroph of E. coli (Thy^-, Pur^-, Try^-) developed a striking increase in sensitivity to the lethal effects of x rays after cultivation in the absence of thymidine. Prevention of RNA synthesis, either by adenine starvation or by the addition of a uracil antagonist, 6-azauracil, during thymidine starvation conferred protection against thymineless death without affecting the development of the radiosensitized state. Omission of tryptophan from the growth medium suppressed both responses. Radiosensitization was expressed when x-irradiation was carried out in air, but not in nitrogen. The sensitized state was reversible by thymidine supplementation of the cultures, with or without concomitant RNA and protein synthesis. There was no significant sensitization to ultraviolet radiation. The x-ray sensitization responses induced by thymidine starvation and by adenine starva-

tion were not additive. For this reason, and because of their similarity with respect to several attributes, they are considered to involve the same molecular mechanism. (auth)

24677 PHOTOREACTIVATION. Setlow, Jane K. (Oak Ridge National Lab., Tenn.). Radiat. Res., Suppl. No. 6, 141-55 (1966). (ORNL-P-1775).

Molecular bases of photoreactivation are discussed. Indirect photoreactivation is differentiated from direct photoreactivation. It is pointed out that the molecular mechanisms of indirect photoreactivation and photoprotection have not been verified. Mechanisms of direct photoreactivation have been better defined because experimental studies have been restricted to the subcellular level, whereas indirect photoreactivation has been studied in whole cells only. Theories for nonphotoreactivable damage are discussed, and the possibility is suggested that both photoreactivable and nonphotoreactivable lesions are pyrimidine dimers. (H.G.D.)

24678 EFFECT OF IONIZING RADIATIONS ON THE SYNTHESIS OF RABIES VIRUS; THEIR USE IN DIAGNOSTIC METHODS. Thiery, G. (Centre d'Etudes Nucleaires, Saclay, France). Office Int. Epizoot., Bull., 60: 147-61(1963). (In French).

The effect of whole-body irradiation of mice and rats on virus formation was studied. Swiss mice and Wistar rats were inoculated intracerebrally with both the street and fixed rabies virus strains. They were exposed on the same day or up to 1½ months later to 25- to 1800-R doses of ^{60}Co γ rays at a dose rate of 160 R/hr. In general, low doses of radiation stimulated virus synthesis and high doses inhibited it. Thus, in mice virus titers in brain were increased considerably after 100 R, slightly increased after 300 R, and decreased after 500. In rats, virus production was elevated by 100 R doses and depressed after 1800 R. A similar effect was found in the incubation period in mice, 25 R shortening it and 800 to 900 R prolonging it. In rats, on the contrary, irradiation did not affect the incubation period. The effect of season, temperature, and sex of the animals on virus development was also studied. (BBB)

24679 PHAGE INDUCTION, FILAMENT FORMATION, AND DEATH FROM LACK OF THYMINE IN ESCHERICHIA COLI B. Mennigmann, Horst-Dieter (Univ., Frankfurt am Main). Zentralbl. Bakteriol. Parasitenk. Infektionskrankh. Hyg., Abt. I, Orig., 198: 282-6(1965). (In German).

In thymine-lacking mutants of E. coli B_3 it was shown that death from lack of thymine is caused by inactivation of the same cell components that are responsible for cell death from uv light. The lytic agent produced by both thymine lack and uv light involves a defective phage. If death from thymine lack was due to phage induction, it would explain the similarity of the effect between thymine lack and uv irradiation. Two groups of E. coli with different responses to prophage and to uv irradiation were studied. There was no parallelism between uv sensitivity and inactivation rate when thymine was restricted. Neither the presence of prophage nor the mechanism of uv sensitivity was uniquely related to death from thymine lack. Microscopic studies of the thymine-deficient cultures showed that in the cultures that died rapidly there was considerable growth of filaments, which also occurred after uv irradiation. The mechanism of effect of death from thymine lack and from uv irradiation appeared to have some common effect related to filament formation. In order to ascertain the cause of death from thymine lack it should be studied in cultures that do not produce phage. (BBB)

24680 ELECTRON MICROSCOPE STUDIES OF THE EFFECT OF RADIATIONS ON THE CYTOPLASM. II. THE LATE EFFECTS OF X RAYS ON THE CYTOPLASM OF PARAMECIUM. Schneider, L. (Univ., Bonn). Protoplasma, 53: 554-74(Mar. 22, 1961). (In German).

Paramecia were exposed to a 150-KR dose of x irradiation and fixed at intervals after irradiation that ranged from 1 hr to 21 days. The late effects that appeared in the cytoplasm were analyzed with the help of an electron microscope. The results showed that small to large areas of the cytoplasm, ranging in size from less than ¼ to as much as 4 μ became encapsulated with membranes that consisted of single or multiple layers. Numerous mitochondria were contained within these capsules. As the cytoplasmic structural elements degenerated, the capsular enclosures gave an appearance of large so called degeneration vacuoles, where residues of tubuli mitochondriales could be found after some time. Fatty degeneration was widely prevalent within 4 hr after irradiation. For the most part, the vacuoles, vesicles, and degenerative vacuoles produced after irradiation collected together in the center of the cell where they coalesced into very large vacuoles, after which they were lost from the cell in a manner which was not entirely clear. (BBB)

24681 ELECTRON MICROSCOPE STUDIES OF THE EFFECT OF RADIATIONS ON THE CYTOPLASM. I. THE EARLY EFFECTS OF X RAYS ON THE CYTOPLASM OF PARAMECIUM. Schneider, L. (Univ., Bonn). Protoplasma, 53: 530-53(Mar. 22, 1961). (In German).

Paramecia were exposed to various levels of x irradiation ranging from very small to lethal doses, and fixed immediately after the end of the exposures. Early effects of irradiation were studied by the electron microscope. These consisted of the appearance of numerous small to large vacuoles and vesicles, an increase in the membranous components of the endoplasmic reticulum, encapsulation of regions of the cytoplasm and of the mitochondria by membranes, a slight swelling of the mitochondria, and some peripheral vacuolization of the mitochondria. These effects and changes in the cytoplasm appeared as early as 1 or 2 min after exposure to extremely high doses of irradiation. The development of the membranes of the vesicles and vacuoles produced as results of the x-ray effect may have arisen from the granular-filamentous structural elements of the cytoplasmic ground substance. Generally, the use of the electron microscope to study the immediate effects of x irradiation made it possible to detect cytoplasmic effects very early after doses that were far below the tolerable limit. (BBB)

24682 INCORPORATION OF ^{32}P AND ^{14}C INTO PHOTOSYNTHETIC PRODUCTS OF ANKISTRODESMUS BRAUNII AS AFFECTED BY X-RAYS. Jeschke, W. D.; Gimmler, H.; Simonis, W. (Univ., Wurzburg, Ger.). Plant Physiol., 42: 380-6(Mar. 1967).

The incorporation of ^{32}P and ^{14}C into organic compounds by Ankistrodesmus is strongly inhibited by x rays. In the same phosphorylated compounds ^{32}P-incorporation apparently is more severely inhibited by x rays than the ^{14}C-labeling. The ^{32}P-incorporation into organic compounds is more strongly inhibited than ^{32}P-labeling of inorganic phosphate in the cell. The inhibition of ^{32}P-incorporation into a number of compounds is strikingly uniform. It is concluded that the inhibition of ^{32}P-incorporation and of ^{14}C-incorporation into phosphorylated compounds in vivo is due to an uncoupling by x rays of photophosphorylation as in vitro. The difference in x-ray-sensitivity of ^{14}C- and ^{32}P-incorporation into one organic phosphorous compound is attributed to a dual action of x rays on ^{32}P-incorporation in organic compounds (both via the uncoupling of photophosphorylation) and only single effect on ^{14}C-incorporation and ^{32}P-labeling of inorganic phosphate. The effect of x rays on ^{14}C-incorporation into organic compounds included inhibition in most cases but also stimulation as in the case of glycolic acid. These differences may be due to interference in the intercellular regulations following the application of x rays. The inhibition of ^{14}C-incorporation in many cases exhibits different behavior at low (<200 krad) and high doses. These changes are discussed on the assumption that at the lower doses of x rays cause uncoupling of photophosphorylation and at the higher doses an addition inhibition of electron transport. (auth)

24683 EXPERIMENTAL INACTIVATION OF HOMOZYGOUS YEAST CULTURES OF VARIOUS PLOIDY. IX. NUCLEIC ACID CONTENT AND NUCLEIC ACID SYNTHESIS AFTER ROENTGEN IRRADIATION. Takamori, Yasuhiko; Lochmann, Ernst-Randolf; Laskowski, Wolfgang (Freie Univ., Berlin). Z. Naturforsch., 21b: 960-7(Oct. 1966). (In German).

The amount of DNA and RNA per dry weight as well as the rate of RNA synthesis was determined in a series of almost isogenic and homozygous Saccharomyces strains of different ploidy, irradiated with different doses of x rays. It was found that the RNA content per dry weight showed only a small decrease after irradiation even with high doses. The decrease in the DNA content after irradiation is larger. It is maximal expressed already at the smallest x-ray dose tested (75 krad). No further decrease could be observed even after application of 225 krad. The RNA synthesis is much more radioresistant in all strains tested (haploid-hexaploid) than the colony forming ability. X-ray doses that reduce the colony forming ability of the cells to less than 1% lead only to a reduction of the RNA synthesis of about 50 per cent. The inactivation of RNA synthesis increases with increasing irradiation doses and increasing incubation time after irradiation. There was only a small difference in the radiosensitivity of the synthesis of soluble or ribosomal RNA. Genetic effects on the radiation inactivation of the colony forming ability, previously described as αα-effect and AS-effect, show no influence on the radiosensitivity of cellular nucleic acid content and synthesis. (auth)

24684 BACTERAEMIA FINDING IN FOWLS THAT DIED AFTER EXPOSURE TO INCREASING X-RAY DOSES. Bodayova, L.; Horakova, V.; Tomanek, J. Vet. Med. (Prague), 11: 529-36 (Aug. 1966). (In Czech).

Studies to ascertain whether bacteremia arises also in domestic fowls after x ray irradiation were investigated. Mature New Hampshire cocks and hens aged 8 to 12 months were used for experiments; and irradiated with different doses of x rays (800, 1000,

1200, 1400, 1600, 1800, and 2000 R). Bacteremia was proved in 13 cases out of 38 decayed animals caused mostly by representatives of the family Enterobacteriaceae (especially Escherichia coli and lactose-negative variant of E. coli), in one case by Streptococcus faecalis var. liquefaciens. Bacteraemia occurred on the third day after irradiation being most expressed between the 6th and 8th days. (auth)

24685 CONTRIBUTION TO THE STUDY OF VIRULENCE ENHANCEMENT IN PATHOGENIC BACTERIA SUBJECTED TO PASSAGE IN IRRADIATED ANIMALS. Mihaiesco-Nigrim, Maria; Benes, S.; Cioranesco, Sanda (Centrul de Radiobiologie si Biologie Moleculara, Bucharest). Arch. Roum. Pathol. Exp. Microbiol., 24: 379-88(June 1965). (In French).

Earlier reports have indicated increased virulence in enteric microorganisms that were isolated from animals with radiation sickness. However, subsequent studies on bacteria passages in irradiated animals have not confirmed this phenomenon. Additional studies were conducted with Salmonella enteritidis. A selected variant (53-872), termed the basic strain, was subjected to 3 successive passages in mice previously irradiated with 700 R x rays and in normal mice. After the 3 passages, the basic strain and two other strains recovered from the animals were inoculated in graded doses, ranging from 1×10^1 to 3×10^8 bacterial cells into eight groups of 30 animals each. The death rates were recorded at the end of 14 days. To compare the effects of the three strains, regression curves were followed and the LD_{50} and their confidence intervals were computed by probit analysis. No enhancement of virulence was demonstrable in the two strains recovered after passage, as compared with the basic strain. It was concluded that the enhancement of virulence in microorganisms after passage in irradiated animals that has been reported by some investigators was due to random variation as a consequence of selection rather than to modification of the bacteria. The controversial results in the literature concerning this phenomenon are discussed. (BBB)

24686 PHYSIOLOGICAL STUDIES ON FILAMENT CELLS. III. THE NUCLEIC ACIDS OF PENICILLIN-INDUCED FILAMENT CELLS AND THEIR ULTRAVIOLET INACTIVATION. Ohkuma, Haruo (Okayama Univ., Japan). Nippon Saikingaku Zasshi, 20: 70-5(Mar. 1965). (In Japanese).

Salmonella typhi H901W cells were incubated in penicillin-containing media (1 unit/ml) to produce elongated filamentous cells. The effect of uv irradiation on growth of the cells and the relation between the nucleic acids and chromatin elements in the filament cells were studied. During the process of filament formation the synthesis of DNA and RNA was not altered. The base compositions of DNA of normal and penicillin-induced filamentous cells were compared. Normally harvested S. typhi H901 showed the following base compositions: adenine 22.8, guanine 27.2, cytosine 27.8, thymine 22.4, and G + C/A + T 1.22. The penicillin-induced filamentous cells contained: adenine 23.4 to 25.8, guanine 22.3 to 27.4, cytosine 26.2 to 29.3, thymine 22.5-25.6, and G + C/A + T 0.95-1.15. Cells were irradiated with a Matsuda 15-W mercury lamp (2357 Å wavelength), and the survival cells were incubated in 0.5% peptone-agar culture at 37°C for 18 hr. No marked increase in the number of filament cells was observed in spite of the multiplication of the chromatin bodies. In cell regeneration experiments S. typhi cells grown in penicillin-containing media were transferred after 4 hr incubation to 50 ml normal saline that was then diluted 1:1000. After transfer to normal saline, 70% of the filamentous cells were regenerated. (BBB)

24687 EFFECT OF PROTECTIVE AGENTS ON THE INACTIVATION OF BACTERIOPHAGE LAMBDA BY X-RAY IRRADIATION. Hradecna, Zdenka; Toufarova, Danuse (Biophysical Inst., Brno). Jad. Energ., 12: 221-2(June 1966). (In Czech).

The protective effects of 2-aminoethylisothiouronium bromide hydrobromide (AET), ascorbic acid, cysteamine, ethanol, glycerol, or sodium chloride were investigated in x-irradiated bacteriophage λ. Glycerol and 1M cysteamine were found to be the most effective protective agents. Radioresistance of the phage was increased by AET, ascorbic acid, and cysteamine under anoxic conditions; no effect due to the amount of oxygen present was found. The mechanism of the protective effect of each substance is discussed. (JPRS)

24688 ACTION SPECTRA FOR LIGHT-INDUCED SPORULATION OF THE FUNGI PLEOSPORA HERBARUM AND ALTERNARIA DAUCI. Leach, Charles M.; Trione, E. J. (Oregon State Univ., Corvallis). Photochem. Photobiol., 5: 631-43(Aug. 1966).

Action spectra were determined for light-induced sporulation Alternaria dauci and Pleospora herbarum. Radiation with less than 370 mμ wavelengths induced formation of conidia; wavelengths of less than 390 mμ induced formation of perithecia. The action spectra were found to be more effective in the 230 and 290 mμ regions, and possibly in the 260 to 270 mμ regions. Below 280 mμ these action spectra may not be representative of the true absorption spectra of the photoreceptors involved because of possible superimposed effects caused by nucleic acid absorption. Though the action spectra were not identical, the number of characters in common were suggestive of a similar photoreceptor. Similarities between action spectra for sexual and asexual reproduction of P. herbarum indicated the possibility of a single photoreceptor for both processes. (BBB)

24689 RADIOBIOLOGICAL AND PHYSICOCHEMICAL PROPERTIES OF 5-BROMODEOXYURIDINE-LABELED TRANSFORMING DNA AS RELATED TO THE NATURE OF THE CRITICAL RADIOSENSITIVE STRUCTURES. Szybalski, Waclaw; Opara-Kubinska, Zofia (Univ. of Wisconsin, Madison). pp 225-40 of Cell. Radiation Biol., 18th Symp. Fundamental Cancer Res. Baltimore, Williams and Wilkins, 1965.

Bacillus subtilis cells grown for two generations in the presence of the thymidine analog 5-bromodeoxyuridine (BUdR) yield 2 classes of DNA: unifilarly labeled (hybrid) and bifilarly labeled DNA molecules, in which up to 100% of the thymidine residues are replaced by BUdR on only 1 or on both DNA strands, respectively. The sensitivities of these two classes of labeled DNA molecules to x rays, to three selected wavelengths of uv light, to subcritical heat inactivation, to critical heat inactivation (melting), and to hydrodynamic shear were assayed and compared with the sensitivity of normal unsubstituted DNA. Genetic transformation toward IND, LEU, and PHE prototrophy served as the assay system for DNA survival. The radiation survival of control and BUdR-labeled B. subtilis cells was also determined. Results showed that bifilarly BUdR-labeled DNA is up to 5, 21, and 26 times more sensitive than the unlabeled DNA to x rays, and to short (254 mμ) and medium (300 to 340 mμ) wavelength uv light, respectively. Similarly, BUdR sensitizes DNA also to subcritical heat inactivation and to hydrodynamic shear. Unifilar labeling results in intermediate sensitization. In contrast to other types of inactivating agents, an actual increase in resistance to long wavelength (350 to 390 mμ) uv light and to critical heat inactivation was observed with BUdR-labeled DNA. Sensitivity of transforming activity to x rays and to short and medium wavelength uv light depends directly on the size of the DNA fragments. Cells which survive exposure to BUdR through one replication cycle are sensitized to uv (254 mμ) and to x rays to the same extent as the unifilarly labeled DNA extracted from these cells, attesting to the role of DNA as the principal radiosensitive cell component. This conclusion is independent of the actual mechanism of radiosensitization by the incorporated BUdR, i.e., whether it increases the intrinsic lability of the DNA structure or whether it interferes with some DNA repair process. That DNA is the critical radiosensitive cell component is further corroborated by the observation that the radiosensitivity of bacterial and mammalian cells is a function of the degree of DNA-labeling by BUdR, while BUdR not incorporated into DNA has no effect on the sensitivity of the cells. (BBB)

24690 ANTIGENIC PROPERTIES OF EXPERIMENTAL VACCINES AGAINST SALMONELLA INFECTIONS, OBTAINED BY GAMMA-IRRADIATION OF LIVE BACTERIA. Servant, P. (Hopital Militaire du Val-de-Grace, Paris). Rev. Corps Sante Armees, 7: 167-75(Feb. 1966). (In French).

The development of a vaccine by radioinduced inactivation of Salmonella typhi TY-2 is described. The ability of the bacilli to multiply was inactivated while retaining their antigenicity. A 28-hr culture of the cells on agar was suspended in 7.5% glucose solution and irradiated with ^{60}Co at a dose rate of 2500 rad/hr to doses up to 200 Krad. A linear inverse relation between the log number of surviving cells vs dose was found over the 0- to 75-Krad range. A sterilizing effect was noted at 90 Krad. A much higher sterilizing dose was required (500 Krad) if irradiation of the cells was carried out in nutrient broth. The lethal dose was about 250 Krad in 7.5% glucose, and a similar result was found for 15% sucrose, and 1.25% Na glutamate solutions. After a sterilizing dose, motility of the cells and continuing respiratory activity could be demonstrated in vitro. Immunization of rabbits with irradiated cells gave agglutinin titers equal or superior to those obtained with nonirradiated cells and considerably higher than with a heated vaccine. The protective action of the irradiated vaccine was equal to but not superior to that of the heated vaccine. (BBB)

24691 GENE-CONTROLLED REACTIVATION OF ULTRAVIOLET-INACTIVATED BACTERIOPHAGE. Harm, Walter (Southwest Center for Advanced Studies, Dallas). J. Cell. Physiol., 58: Suppl. 1, 69-77(Dec. 1961).

The results reported give evidence for a type of reactivation, revealing a difference in uv sensitivity between the closely related phages T2 and T4. For any given survival level, T4 needs about twice the uv dose as does T2, although these 2 phages contain equal amounts of DNA and do not differ noticeably in their sensitivities to x rays or ^{32}P decay. The uv sensitivity of T2 and

T4 is a heritable character controlled by a single gene, called u, closely linked to the r 17 locus of T2. This gene controls also the extent of photoreactivation (PR) in such a manner that the greater uv sensitivity (corresponding to the u^+ allele) is accompanied by a higher PR, and the smaller uv sensitivity (corresponding to the u allele) is accompanied by a lower PR. The mechanism by which a single gene difference is able to control these great differences in lethality and reactivability is examined. The uv survival of u^+ phage when infecting cells contained additionally an intact u gene was studied. Evidence was found that an intact u gene present within a cell can modify the survival of a u^+ phage infecting the same complex by preventing lethality of about half of the hits. For this effect the term u-gene reactivation is introduced. It occurs obligatorily in T4, thus causing the reduced uv sensitivity of this phage as compared with T2. (BBB)

Radiosterilization and Radiopreservation

Refer also to abstracts 24142 and 24309.

24692 (AECD-RB-5) A REVIEW ON PROBLEMS ASSOCIATED WITH PRESERVATION OF STORED RICE IN PAKISTAN. Matin, Abdul; Amin, Ruhul; Hamid, M. A. (Atomic Energy Centre, Dacca (Pakistan)). Dec. 1966. 28p. Dep.

Problems associated with the storage of rice are reviewed. Application of γ radiation processing for the eradication of fungi and insects causing spoilage of stored rice are discussed. Insects infesting rice were killed by exposure to a dose of 16 Krad γ radiation. Results are presented from preliminary studies on the effects of various doses of γ radiation on the color, flavor, odor, taste, and texture of rice exposed both before and after the husk was removed and before and after the rice was parboiled. (C.H.)

24693 (UCD-34P73-12) IRRADIATION OF FRUITS AND VEGETABLES. Sommer, N. F.; Maxie, E. C. (California Univ., Davis. Dept. of Pomology). June 1967. Contract AT(11-1)-34. 13p. (CONF-660826-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 17th Proceedings of the International Horticultural Congress, College Park, Md.

Feasibility and techniques of using radiation as a fungicide are discussed. Investigations to date have resulted in the following conclusions: there is no significant loss in nutritive value after radiation doses that living fruits and vegetables can tolerate. There is no induced radioactivity, and animal feeding trials have indicated that irradiated foods are safe. Irradiation cannot in any degree substitute for refrigeration, but highly perishable commodities harvested near full-ripe generally best tolerate irradiation and show greatest benefits. Irradiation doses the commodities can withstand are often insufficiently fungicidal unless combined with other treatments to provide a synergistic effect. (auth)

24694 (JPRS-40232) EFFECT OF GAMMA IRRADIATED PLANT FOOD ON MONKEYS. Okuneva, L. A.; Shillinger, Yu. I.; Maganova, N. B. Translated from Vop. Pitan., 25: No. 3, 52-8(1966). 9p. (TT-67-30878). CFSTI.

A diet consisting of ^{60}Co γ-irradiated dried and fresh fruits, vegetables, and bread from irradiated wheat was fed to nine macaca-rhesus monkeys. The test group consisted of one male and four females; one female had a four-month-old infant. The control group consisted of one male and three females. The monkeys were fed three times a day with the test diet for 11 months. During the period of observation the female monkeys in both groups either became pregnant or bore an offspring. Results showed that the test monkeys did not differ significantly in development of offspring or in general conditions of health. Blood morphology indicators and levels of cholesterol, lipoproteins and protein in the blood were all well within normal limits. (B.H.S.)

24695 REPRODUCTIVE POTENTIAL OF THE SWEET POTATO WEEVIL AFTER EXPOSURE TO IONIZING RADIATIONS. Walker, John R. (Louisiana State Univ., Baton Rouge). J. Econ. Entomol., 59: 1206-8(Oct. 1966).

Attempts were made to reduce the reproductive potential of the sweet potato weevil Cylas formicarius elegantulus, by the introduction of radioinduced sterile males into the population. When adult male weevils (2-5 days old) were irradiated with ^{60}Co γ rays and mated, the percentage egg hatch decreased as irradiation dose increased. The mean percent egg hatch for untreated matings was 83.6 as compared with 0.4 for matings where males were exposed to 18,000 R. Matings using males exposed to 3000, 6000, 9000, 12,000 and 15,000 R revealed egg hatches of 73.9, 42.9, 29.4, 6.9, and 5.6%, respectively. Irradiated males competed favorably with untreated males for virgin females. Matings involving 4 sterile males, 4 untreated males, and 4 untreated virgin females gave an average of 55% egg hatch. There was no subsequent reduction in the number of progeny produced when virgin females were first mated with untreated males and later with irradiated males. Radiosensitivity decreased as the age of the weevils increased. The results show that adult male weevils can be sterilized by exposure to 20,000 R without adversely affecting their ability to compete with untreated males for females. (BBB)

24696 THE WORLD'S FIRST LARGE SCALE CONTINUOUS GRAIN IRRADIATION PLANT, ISKENDERUM, TURKEY. Atom, No. 124, 27-30(Feb. 1967).

A ^{60}Co gamma irradiation plant was designed to treat 30 tons of wheat per hour, with an absorbed radiation dose of 16,000 rads. Its maximum handling capacity is 50 tons per hour, and barley, rye, and maize can also be treated. It is designed to employ 200,000 Ci of ^{60}Co, but could accommodate 360,000 Ci. The following aspects of plant design and operation are included: cooling, safety, processing costs, control of grain flow, variable speed drive mechanism, and building design. (UK)

24697 EFFECT OF PACKAGING ON THE MAJOR MICROBIAL FLORA OF IRRADIATED HADDOCK. Sinskey, T. J. (Massachusetts Inst. of Tech., Cambridge); Pablo, I. S.; Silverman, G. J.; Ronsivalli, L. Nature, 213: 425-6(Jan. 28, 1967).

It is stated that a factor which has been neglected in studies on the irradiation preservation of sea foods is the effect of packaging and accessibility of air on microflora growth patterns. In the investigation described, haddock fillets were packaged in cans (a) without hermetic sealing but covered with aluminium foil to allow free exchange of air, (b) sealed with a limited air headspace, (c) vacuum packed. The samples were exposed to 150 Krads and then stored at 3°C for 3 weeks. Results indicated that the microbial spectrum is altered by the presence of air during refrigerated storage. A detailed analysis of microbial species is given. (INIS-UK)

24698 A COMPARISON OF TOXIN PRODUCTION BY CLOSTRIDIUM BOTULINUM TYPE E IN IRRADIATED AND UNIRRADIATED VACUUM-PACKED FISH. Cann, D. C. (Torry Research Station, Aberdeen, Scot.); Wilson, Barbara B.; Shewan, J. M.; Roberts, T. A.; Rhodes, D. N. J. Appl. Bacteriol., 29: 540-8(Dec. 1966).

Possible use of pasteurizing doses of radiation to extend the storage life of fish or fish products was investigated, and in particular the time for toxin production at 10°C from spores in fish after irradiation at a pasteurizing dose was determined. The fish were inoculated first, so that the spores themselves were irradiated, and some inactivated, and the growth subsequent to germination took place on irradiated fish. The time for toxin production was compared with that for comparable numbers of unirradiated spores in unirradiated fish. Toxin production by inocula of 10^5, 10^4, 10^3, and 10^2 spores of Clostridium botulinum type E in vacuum packed herring, cod, and haddock were compared with that of equivalent numbers of spores surviving γ irradiation at 300,000 rads. There was little difference between the rates of toxin production in unirradiated and irradiated fish. More toxin was produced in irradiated herring than in unirradiated, but in haddock the reverse was obtained. In cod about equal amounts of toxin were found without trypsinization; after trypsinization toxin levels were generally higher in irradiated samples. (BBB)

24699 MATING BEHAVIOR OF THE SCREW-WORM FLY AS AFFECTED BY DIFFERENCES IN STRAIN AND SIZE. Alley, D. A.; Hightower, B. G. (Agricultural Research Service, Mission, Tex.). J. Econ. Entomol., 59: 1499-1502(Dec. 1966).

The effects of differences in strains and size on the mating frequency of male screw-worm flies, Cochliomyia hominivorax, were studied in observed mating tests with a recently colonized (Mexican) and a lab-adapted (Florida) strain of flies. Large or small males were obtained by rearing the flies on 2 different artificial media. Sterilization of some males by exposure of pupae to 6000 R γ radiation was also studied. Differences in mating frequency among male flies that were attributable to strain disappeared after the Mexican flies had been colonized for 15 generations. However, differences in mating frequency between large and small Florida males persisted, regardless of the strain of the female flies, when the females were as large as flies in natural populations. No differences existed between the mating frequency for the larger irradiated males reared on meat or wounds and the unirradiated wound-reared control males. Means of unsuccessful attempts to mate ranged from 4.7 to 6.8 among irradiated and normal Mex males compared with means of 18.9 to 21.4 among both groups of Fla. males. No difference existed in mating frequency between irradiated and normal males of the Mex. strain. (BBB)

24700 TREATMENT OF MEATS WITH IONIZING RADIATIONS. VIII. pH, WATER-BINDING CAPACITY, AND PRO-

TEOLYSIS OF IRRADIATED RAW BEEF AND PORK DURING STORAGE, AND THE ATP-ase ACTIVITY OF IRRADIATED RABBIT MUSCLE. Lawrie, R. A.; Sharp, J. G.; Bendall, J. R.; Coleby, B. (Low Temperature Research Station, Cambridge, Eng.). J. Sci. Food Agr., 12: 742-51(Nov. 1961).

The use of electrons for the radiation processing of meats is discussed. Results are reported from studies on the pH, water-binding capacity, and proteolysis of irradiated beef and pork during storage. The effects of radiation on the ATPase activity of rabbit muscle was also studied. (BBB)

24701 EFFECT OF IRRADIATION ON STORAGE QUALITY OF POTATOES. Sawyer, R. L.; Dallyn, S. L. (Long Island Vegetable Research Farm, Riverhead, N. Y.). Amer. Potato J., 38: 227-35(June 1961).

Studies on six varieties of potatoes were conducted with γ radiation and fast electrons to determine the levels of irradiation that would give satisfactory commercial control of sprouting without detrimental side effects such as rot and the various darkening discolorations associated with the potato tuber. Sprouting in Green Mountain and Katahdin varieties was inhibited at lower doses of irradiation more so than in other varieties tested. Doses of 5000 to 7000 R gave good commercial control with Green Mountain and Katahdin, whereas, considerable sprouting was still evidenced at 10,000 R with Cobbler, Russet Burbank, and Kennebec varieties. Commercial control of sprouting, for long-term periods, could be obtained with most important potato varieties at radiation doses of 7500 to 12,500 R. Storage rot was increased by irradiation; usually this was not encountered at the levels of irradiation necessary for commercial control of sprouting. Black spot of potatoes was increased by irradiation at levels necessary for commercial control of sprouting with most varieties tested. After cooking, darkening of potatoes was increased by treatment at levels necessary for commercial control of sprouting with most varieties tested. Irradiation at 12,500 R caused a reduction in both normal and wound perioderm formation. (BBB)

24702 PROGRESS IN FOOD IRRADIATION. Ingram, M.; Rhodes, D. N. (Low Temperature Research Station, Cambridge, Eng.). Food Manuf., 37: 318-25(July 1962).

Radiopasteurization and radiopreservation of foods are reviewed. The primary limitation lies in the production of damage to the organoleptic quality, either immediate or delayed. After low dose treatments (0.01–0.1 Mrad), foods are usually indistinguishable by odor and flavor from the untreated material, although in some cases changes in color occur. Two main possibilities for low-dose treatment can be distinguished: the delay or prevention of breaking of dormancy in vegetables, and the destruction of infesting insects in stored grains and dried fruits or animal parasites in meats. With medium-dose treatments (0.1–1.0 Mrad), the main objective is the destruction of the microorganisms contaminating foods. Such treatment may result in the removal of bacteria dangerous to man or simply in the extension of storage life of perishable commodities by the general reduction of contamination. Specialized processes (1–3 Mrad), intermediate between pasteurization and sterilization treatments, aim at near but not complete sterilization in special products where a low bacterial count is desirable. High-dose treatments (~5 Mrad) usually aim to produce sterility in an otherwise perishable food, which means either the total absence of bacteria, over a large number of containers, or that the few surviving organisms are so damaged as to be unable to develop in the environment of the particular food (commercial sterility). Canned hams treated with doses of 0.6 Mrad and heated to 75° remain satisfactory in quality, while most of the bacteria are destroyed and the irradiated product is at least as stable as the corresponding heated one. Problems to be overcome in radiation processing are discussed. (TSS)

24703 CONTROL OF INSECTS IN STORED GRAIN BY IRRADIATION. Cornwell, P. B. (Roentokil Labs. Ltd., East Grinstead, Eng.). Proc. Int. Food Ind. Congr., London, 1964, 205-5[Publ. 1965].

A review of the present state of knowledge and the steps being taken to encourage the application of ionizing radiations for disinfestation of grain is given. The grain is treated in motion, passing through a shield housing the source or machine that delivers the required dose of radiation. Consideration of the physical properties of γ and electron radiations suggest that grain should be treated during gravity fall. The dose level for grain disinfestation (16,000 rads) does not adversely affect the milling, baking or organoleptic properties of wheat, nor does several times this dose. There is no loss in nutritional adequacy and there is no induced toxicity. The minimum annual throughput of grain which can be treated economically by irradiation is about 200,000 tons. The operating costs are competitive with those for conventional measures of insect control. The reliability of ^{60}Co plant and electron machines under conditions of commercial grain handling would require pilot operation for evaluation. (TSS)

24704 RADIATION PRESERVATION. Hansen, Poul-Ivar E. (Danish Meat Reserach Inst., Roskilde, Denmark). Medlemsbl. Dan. Dyriaegefor., 49: 120-6(Feb. 1, 1966). (In Danish).

A review is given of the use of ionizing radiations for food pasteurization and sterilization. The relative advantages of γ radiation, usually from ^{60}Co, and electron beam radiation for sterilization of various products are compared. Electrons are of limited value for bulk material, since maximum penetration (approx. 0.5 cm/MeV) and effective penetration (0.35 cm/MeV) are relatively low when contrasted with ^{60}Co γ rays. Doses required vary from 50,000 rads to eliminate insects in stored grain to 1 Mrads or more to inactivate bacterial spores. In most foods so far tested, sterilizing doses of 4 to 5 Mrads have produced objectionable odors and flavors in the irradiated products, whereas such changes are usually minimal or absent with pasteurizing doses (0.1 to 1 Mrad). Problems of acceptability of irradiated foods from a safety viewpoint are also considered, and regulations introduced in the United States, Canada, and the USSR which allow bacon, potatoes, and a few other products to be irradiated for consumer use are discussed. A table shows the various food products which have so far been examined as candidates for radiation preservation, showing doses used and effects produced. The program for potato irradiation, to prevent sprouting, being conducted in Greenland is described. (BBB)

24705 GAMMA IRRADIATION OF MEATS AT VERY LOW TEMPERATURE: ATTEMPT TO IDENTIFY THE CAUSES OF SPOILAGE. Morre, Jean (Service Veterinaire, Paris). Bull. Acad. Vet. France, 38: 325-8(Oct. 1965). (In French).

The reaction mechanisms of the formation of dialdehydes in γ-irradiated beef were studied. The ^{60}Co γ irradiation was conducted at the temperature of liquid nitrogen (–195°C) so that the secondary phenomena taking place could be separated from the primary ones. Three doses used were 0.5, 1, and 2 Mrad. At this temperature there was no absorption at 535 mμ when tests with thiobarbituric acid (TBA), used to complex with the reaction products, were conducted. Further experiments were conducted by irradiating the beef at the same temperature and subsequently preserving it for 5 days at –20°C. A weak TBA reaction was present in samples receiving 0.5 and 1 Mrad and a more positive one with 2 Mrad. Reactions with TBA were stronger when samples irradiated at the same temperature were preserved for 5 days at 4°C and comparable to those obtained when the material was irradiated at ambient laboratory temperature. It was concluded that the carbonyl-containing compounds detected in irradiated meat were secondary products, appearing slowly as a result of the action of the free radicals formed. Irradiation has the effect of accelerating the normal degradation processes occurring in muscle. (BBB)

24706 PHYSIOLOGICAL STUDIES OF GAMMA IRRADIATED TOMATO FRUITS. Abdel-Kader, Adel Saad El-din Fahmy. Davis, Calif., Univ. of California, 1966. 111p.

Thesis.

Fruits of the Early Pak No. 7 and ACE varieties harvested at various stages of ripeness were irradiated in a Cobalt 60 source at levels mostly within a pasteurizing range. The physiological responses, including respiratory rate, ethylene production, ripening, shelf-life, quality, ascorbic acid content, pH, total acidity, soluble solids, textural changes, weight loss, gas exchange and permeability were measured. (TSS)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

24707 (ALO-3632-14) QUARTERLY PROGRESS REPORT IN A THERMAL INSULATION STUDY, JANUARY-MARCH 1967. DeWitt, W. D. (Union Carbide Corp., Indianapolis, Ind. Linde Div.). May 5, 1967. Contract AT(30-1)-3632. 48p. Dep. CFSTI.

Small scale processing tests were conducted on Cu flake opacified Refrasil quartz fiber paper, Astroquartz cloth, and Refrasil quartz fiber paper. This completes the planned processing experiments. Offgassing rates and gaseous compositions were determined for the following insulation materials: Al foil, Cu foil, Ni foil, Ta foil, glass fiber paper, Al flake opacified glass fiber paper, Refrasil quartz fiber paper, Cu flake opacified Refrasil quartz fiber paper, Astroquartz cloth. A sample getter requirement calculation is presented. This completes the planned offgassing study. Thermal conductivity data is presented for the copper foil-Refrasil quartz fiber paper composite and the Ta foil-Astroquartz cloth composite. The Cu foil-Refrasil quartz fiber paper composite has completed 1,750 hours of a scheduled 2000 thermal performance test at 1260°F with no degradation of thermal performance. A Cu foil-copper flake opacified Refrasil quartz fiber paper composite has been installed on a thermal conductivity tester and testing will be initiated in the next reporting period. A Ni foil-Refrasil quartz fiber paper composite is being installed on a thermal conductivity tester. The vacuum enclosure-insulation materials compatibility test apparatus and the second vacuum enclosure test specimen, Hastelloy-X, were assembled. A 2000 hour test was initiated during the period. (auth)

24708 (ALO-3634-04) RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS. Quarterly Progress Report, November 1966-January 1967. Dunlay, J. B.; Fronduto, J.; Paquin, M. L.; Poirier, V. L. (Thermo Electron Engineering Corp., Waltham, Mass.). Apr. 28, 1967. Contract AT(30-1)-3634. 116p. Dep. CFSTI.

Progress is reported on the development of high temperature thermal insulation. Planar heat transfer test results are presented for W-ThO_2 insulation samples. Spray coating techniques are described for applying thin oxide layers to refractory metal foils. Designs are shown for cylindrical thermal conductivity and edge heat loss test assemblies. Preliminary results are given for heat losses through Re support insulation configurations. Life test results are presented on the thermal and outgassing characteristics of insulation samples after 100 hours and 500 hours of operation at 1700°C and 1900°C. (auth)

24709 ZIRCONIUM AND ITS ALLOYS. Fall Meeting of The Electrochemical Society held October 10-14, 1965, in Buffalo, New York. Pemsler, J. P.; Perryman, E. C. W.; Smeltzer, W. W. (eds.). New York, The Electrochemical Society, Inc., 1966. 253p. (CONF-651017).

Forty-two articles are included. Each has been previously abstracted in NSA as: Vol. 20: 20705, 21282, 24995, 25496, 25497, 25498, 25499, 25500, 25501, 25502, 25503, 25504, 25505, 25506, 27421, 27435, 27436, 27437, 27438, 27439, 27599, 27600, 27601, 27602, 27603, 27604, 29737, 37172, 37198, 37226, 37227, 37228, 37229, 37230, 37231, 37232, 37233, 37234, 37235, 37236, 37237, and Vol. 21: 14857. (J.G.B)

24710 FIRST LATIN AMERICAN CONFERENCE ON PROCESS METALLURGY AND METAL WORKING, BUENOS AIRES, 18-23 AUGUST, 1964. VOLUME 2. Buenos Aires, Comision Nacional de Energia Atomica, 1966. 397p. (CONF-640821-(Vol.2)).

A total of 20 papers are included in the volume. These papers are concerned with corrosion of metals, fabrication of porous plates, calculation of forces for metal forming, solutions for impurity problems in α copper and brass, properties of foundry sands, aspects of metal forming, metal working and processing, development and improvement of metallic materials, production of seam-welding electrodes, properties of stable high-conductivity Cu alloys, nonferrous metal sheet production, materials research relations with design optimization, explosive working of metals, continuous casting of Al, new metal processing methods, roll-bonding metals, fatigue of structural and machine members, metallurgical research in Latin America, and collaboration on technological searching. (J.R.D.)

24711 FIRST LATIN AMERICAN CONFERENCE ON PROCESS METALLURGY AND METAL WORKING, BUENOS AIRES, 18-23 AUGUST, 1964. VOLUME I. Buenos Aires, Comision Nacional de Energia Atomica, 1966. 428p. (CONF-640821-(Vol.1)).

A total of fifteen papers are included in the volume. An abstract was prepared for one paper. Papers for which no abstracts were prepared are concerned with recent developments in engineering materials and processes; activities at the University of Uruguay metals casting laboratory; metallurgical contributions of the Technological Research Institute of Sao Paulo; activities of the Service of Technical Assistance to Industry, CNEA, Argentina; metallurgical research in Chile; physical metallurgy of iron and steel; new ultrahigh-strength steels; use of constructional steels; properties of cellular metallic materials; steel weldability; processing of refractory metals; hardening construction steel; compacting Al alloys; and corrosion resistant Si iron for chemical plants. (J.R.D.)

For an abstract of the individual paper see: 24712.

24712 PLAN OF THE ACTIVITIES OF THE DEPARTMENT OF METALLURGY OF THE NATIONAL ATOMIC ENERGY COMMISSION, ARGENTINA. Sabato, Jorge A. pp IV1-11 of First Latin American Conference on Process Metallurgy and Metal Working. Vol. 1. Buenos Aires, Nacional de Energia Atomica, 1966. (In Spanish).

The activities of the department are directed toward research and development, assistance in the technical direction of industrial metallurgy in Argentina, and training. The work carried out in each of these lines during the period 1957 to 1963 includes publications, sponsoring scientific meetings, administering research contracts, administering subsidies, obtaining patents, fuel element development, and monitoring the work of foreign metallurgy experts. (J.R.D.)

Corrosion and Erosion

Refer also to abstract 24746.

24713 (KFK-408) DIE BILDUNG NEUER METALLISCHER PHASEN AN DER OBERFLAECHE VON MIT FLUESSIGEM NATRIUM VON 600°C IN KONTAKT STEHENDEN METALLEN. (The Formation of New Metal Phases on the Surfaces of Metals in Contact With Liquid Sodium at 600°C). Borgstedt, Hans Ulrich (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerporschung). Oct. 1965. 8p. (In German). Dep. mn.

The mass transport occurring when a plate of Incoloy 800 in a capsule of V4A-steel was placed in contact with liquid Na at 600°C was studied. After 1000 hours of contact the corrosion rate was measured by microgravimetric methods as 4.0 ± 0.1 mg/dm^2 month. Small crystals three to five μ in diameter and obviously cubic were growing on the Incoloy 800 sheet. The microcrystals were at the grain boundaries of the Incoloy 800. The chemical composition and the structure of the crystals was not determined. (J.S.R.)

24714 (N-67-12093) POTASSIUM CORROSION TEST LOOP DEVELOPMENT. Quarterly Progress Report, Period Ending April 15, 1966. Hoffman, E. E. (ed.) (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). July 22, 1966. Contract NAS3-2547. 76p. (NASA-CR-72042; QPR-11). CFSTI $3.00 cy, $0.65 mn.

The prototype test loop is intended for the evaluation of refractory alloys in boiling and condensing K environments which simulate project space electric power systems. Progress in a 5000-hour operation test is reported. Na and K were distilled from the loop components and samples were taken from each circuit during the draining operation. Calibration of the slack diaphragm pressure transducers and their response characteristics are discussed. The test loop proper and the components were inspected for system degradation or contamination. The Mo-TZM alloy turbine simulator nozzle and blade specimens were evaluated for corrosion or erosion. Evaluation of the test results failed to disclose any significant changes in the condition of the prototype corrosion loop. A preliminary chemical analysis of Pb-1Zr foil and tube specimens indicated that only slight oxygen contamination resulted from exposure in the vacuum environment during the 5000-hour test. (STAR)

24715 (ORNL-tr-1606) CORROSION OF VANADIUM AND ITS ALLOYS IN LIQUID SODIUM. Champeix, L.; Darras, R.; Sannier, J. Translated for Oak Ridge National Lab., Tenn., from paper Presented at IAEA Symposium on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna, Austria, Nov. 29-Dec. 2, 1966. 20p. (CONF-661110-17). Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The effects of various addition elements on the corrosion resistance of V to liquid Na were studied at 600°C. The additions used were Al, Si, Ti, Cr, Zr, Nb, and Mo. The results showed that V or its alloys are entirely compatible with liquid Na provided that the latter is carefully freed from oxygen by means of a hot trap. However, none of the binary alloys studied seemed to be usable over a long period of time in the presence of liquid Na that had been purified only by a cold trap. The most favorable addition elements were Cr, Al, and possibly Mo. Interest in Ti can only be of a metallurgical nature. (P.C.H.)

24716 (ORNL-tr-1623) INTERGRANULAR CORROSION OF AUSTENITIC STAINLESS STEELS IN HIGHLY OXIDIZING ACID MEDIA. Coriou, H.; Desestret, A.; Grall, L.; Hochmann, J. Translated for Oak Ridge National Lab., Tenn., from Corros. Anti-Corros., 14: 163-70(1966). 16p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

The close relationship that exists between the potential of the metal and the attack rate is illustrated. The results obtained led to the conclusion that austenitic steels containing Cr and Ni and about 4% Si in highly oxidizing acid media (HNO_3) are very resistant, whereas steels containing about 1% Si disintegrate under a strong intergranular attack. (auth)

24717 (ORNL-tr-1626) STAINLESS STEELS WITH A SILICON ADDITION: GENERAL STUDY OF THEIR BEHAVIOR IN HIGHLY OXIDIZING ACID MEDIA. Coriou, H.; Demestre, J.; Desestret, A.; Grall, L. Translated for Oak Ridge National Lab., Tenn., from Rev. Met. (Paris), 62: 1193-1203(1965). 22p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $2.60 fs, $0.86 mf.

Studies were made on the effects of Cr and Ni content on the corrosion of stainless steels containing Si in HNO_3 media. It was found that the increase of proportion of Cr up to 20%, with 18% Ni and 4% Si, improved the resistance in rather concentrated HNO_3 media, for example, of 11 to 14 N. The influence of the Si content with steels containing different amounts of Cr and Ni was also confirmed: in highly oxidizing HNO_3 solutions, the corrosion rate was maximum with about 1% Si in all cases investigated. The filler metal which constituted the best compromise between cracking resistance and corrosion resistance was determined to be 20% Cr, 14% Ni, 7% Mn, 3.7% Si, and less than 0.030% C. (P.C.H.)

24718 (ORNL-tr-1628) STUDY OF CHROME-NICKEL-IRON AUSTENITES FOR THEIR CORROSION BEHAVIOR FROM THE STANDPOINT OF THEIR APPLICATION IN THE NUCLEAR FIELD. Coriou, H.; Grall, L.; Pelras, M. Translated for Oak Ridge National Lab., Tenn., from paper Presented at the 3rd International Conference on Metallic Corrosion, Moscow, May 25, 1966. 33p. (CONF-660514-4). Dep. CFSTI. JCL $3.60 fs, $1.19 mf.

A review of corrosion studies made on austenitic Cr-Ni-Fe alloys used for the construction of reactors or plants for the processing of irradiated fuels is presented. The media used included deionized water, steam, and chloride, alkaline, and nitric acid solutions. Particular attention was given to intergranular corrosion and stress corrosion. Additions of Mo and Si were also considered, as was the corrosion of Inconel 600. (auth)

24719 MAGNESIUM ALLOYS IN TERPHENYLS: CORROSION INHIBITORS. de Beni, G. F. (CCR-EURATOM, Ispra, Italy). J. Nucl. Mater., 22: 158-64(May 1967).

Results are given about the behavior of some Mg alloys (principally Al 80 and Zr 55) submitted to corrosion in an organic coolant in the presence of inhibitors. In the presence of only some hundreds ppM of CO_2 and NH_3 (or light amines), the corrosion rate in wet terphenyl at temperatures up to 440°C was reduced by a factor of 100 or more. MgO formed on surfaces of Mg alloys in these conditions is compact and adherent. The corrosion rate still diminishes after 2000 hr of exposure to terphenyl. (auth)

24720 KINETICS OF THE OXIDATION OF TANTALUM BY WATER VAPOR. Adelsberg, L. M. (Corning Glass Works, N. Y.); St. Pierre, G. R.; Speiser, R. Trans. Met. Soc. AIME, 239: 490-6(Apr. 1967).

Studies of scale formation on Ta held in H_2O-H_2-Ar gas mixtures at temperatures between 840 and 1250°C related oxidation to gas composition and temperature. It was found that water-vapor partial pressure determines the oxidation rate at a given temperature and that the O_2 potential as fixed by the water vapor to H_2 ratio has no significant effect on the oxidation rate. The Ta_2O_5 scale formed during oxidation is composed of an inner lattice-diffusion barrier and an outer layer of cracked/porous oxide, which does not retard the oxidation process. For each gas composition and temperature investigated, the oxidation rate becomes constant after a short adjustment period. It is shown that a constant oxidation rate may prevail even though the thickness of the inner lattice-diffusion layer of Ta_2O_5 changes. The initial curvature of the typical "paralinear" oxidation curve may result from causes other than an increasing thickness of the inner protective layer. (auth)

24721 HIGH-TEMPERATURE OXIDATION OF METALS. Kofstad, Per. The Corrosion Monograph Series. New York, John Wiley and Sons, Inc., 1966. 351p. $13.50.

A comprehensive description is given of the fundamental aspects and reaction mechanisms encountered in high temperature oxidation of metals and alloys. Specific subjects treated include: adsorption and initial oxide formation; defect structures in oxides; diffusion in oxides; formation of compact oxide scales at high temperatures; dissolution and diffusion of oxygen in metals; oxygen dissolution and oxide scale formation; oxidation of Group IVA and VA metals; porous scales; phase boundary reactions; adsorption as rate-limiting factor; oxide evaporation; oxidation of W; oxidation of alloys; and coatings for oxidation protection at high temperatures. (P.C.H.)

24722 IMPROVEMENTS IN OR RELATING TO THE ELECTROLYTIC ETCHING OF ZIRCONIUM AND ZIRCONIUM-BASE ALLOYS. Delafosse, Jacques; Herenguel, Jean; Lelong, Pierre; Silberman, Simon (to Commissariat a l'Energie Atomique). British Patent 1,067,911. May 10, 1967. Priority date Oct. 1, 1963, France.

A process for electrolytic etching of Zr and Zr-base alloys is described in which the metal is subjected to electrolysis as an anode in an electrolytic bath consisting of a mixture of HNO_3 and a source of fluoride ions. The process can be used to form a controlled-thickness oxide film on the metal leaving a smooth surface and making it possible to maintain geometrical dimensions within predictable tolerance ranges. (J.R.D.)

Preparation and Fabrication

Refer also to abstracts 24746 and 25668.

24723 (BM-RI-6882) ELECTROWINNING AND TAPPING OF LANTHANUM METAL. Shedd, Edward S.; Marchant, J. D.; Henrie, T. A. (Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center). June 1966. 12p.

An investigation was made on electrowinning and tapping La metal from La_2O_3 in a fluoride bath. The electrolyte was composed of LaF_3, BaF_2, and LiF. Metal containing 0.2 percent impurities was produced at a rate of over 2 pounds per hour. Principal impurities were Ca, Al, and Si. Low-carbon metal was produced by continually discharging the carbon oxide gases and maintaining 0.1-atmosphere pressure. Anode reactions and cell design were found to be important factors in cell operation. Both frozen electrolyte skulls and W metal crucibles proved satisfactory for collecting the metal and did not react with the molten La. (auth)

24724 (BMI-1796) DENSE ISOTROPIC GRAPHITE FABRICATED BY HOT ISOSTATIC COMPACTION. Carmichael, Donald C.; Chard, William C.; Brockway, M. Clifford (Battelle Memorial Inst., Columbus, Ohio). Mar. 31, 1967. Contract W-7405-eng-92. 36p. Dep. CFSTI.

Graphite bodies were prepared by the hot-isostatic-compaction process to obtain densities in the range of 2.20 to 2.24 per cm^3 (95 to 99 percent of theoretical) with a high degree of isotropy. Of the graphite starting materials which were compacted and tested, a high-purity artificial powder and a commercial bulk (not powdered) material resulted in this combination of properties. The processing was accomplished at approximately 2700°C for 30 min using a He-gas pressure of 900 atm. The isotropic characteristics of the materials were determined by measurements of x-ray diffraction, electrical resistivity, and linear thermal expansion. On the basis of the property evaluations, samples of the most dense and isotropic materials were fabricated for irradiation testing at Battelle-Northwest. (auth)

24725 (BNWL-414) A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS. Quarterly Progress Report, April 1-October 1, 1966. Kemper, R. S.; O'Keefe, D. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1967. Contract AT(45-1)-1830. 21p. Dep. CFSTI.

Electron beam remelted Tc-W alloys were forged while encapsulated in Mo cans to 0.275 to 0.300 in. thickness in one press. A forging temperature of 1675 to 1700°C was used. The 50 and 60 at.% Tc alloys fractured badly and penetrated the Mo can surface and caused some contamination problem. Small particles of the 60 at.% alloy were hard enough to be imbedded in the press anvil. The surface appearance of the as-forged alloys is illustrated. The effects of Tc in reducing grain size was quite pronounced. (P.C.H.)

24726 (N-67-11824) FABRICATION OF A BERYLLIUM TEST PANEL. Jones, G. H.; Wood, C. M. (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). Oct. 29, 1966. 37p. (NASA-TM-X-53529). CFSTI $3.00 cy, $0.65 mn.

The fabrication of beryllium test panel made in support of pro-

jected programs which will use Be for major structural applications is described. Manufacturing techniques involved were machining, forming, etching, and assembly. By using proper tooling and by exercising close controls over each operation, the panel was fabricated to the required configuration and tolerances. (auth)

24727 (N-67-13536) DEVELOPMENT OF HIGH-TEMPERATURE CHROMIUM ALLOYS. Semiannual Report. Clark, J. W.; Wukusick, C. S. (General Electric Co., Cincinnati, Ohio. Materials Development Lab. Operation). Apr. 22, 1966. Contract NAS3-7260. 57p. (NASA-CR-80657; SAR-2). CFSTI.

Some 40 Cr alloys have been induction melted, cast as ingots of about four pounds each, and processed to small-diameter bar stock. In addition, over 150 compositions were arc melted as 40 to 100 grams buttons and were selectively evaluated with respect to critical properties. Several of the dilute dispersion-strengthened alloys exhibited ductility at sub-zero temperatures combined with tensile strengths over 35,000 psi at 1900°F. Addition of 4 at. % Mo raised the tensile strength of carbide-containing alloys to about 60,000 psi at 1900°F, with the expected expense to low-temperature ductility. Additions of W were even more effective strengtheners, with tensile strengths of 81,000 and 30,000 psi at 1900 and 2400°F, respectively being measured in a Cr-6W-1Y alloy, but had a more detrimental effect on the workability than did Mo. The most promising approach identified in the button alloys was the use of La to inhibit nitridation and consequent embrittlement during air exposure at elevated temperatures. Even compositions containing carbides rich in Nb or Ta, which otherwise are highly susceptible to nitrogen attack, resisted such attack in alloys with additions of 0.3 to 0.5 at. % La. Lower concentrations were equally effective in alloys with Group IV A carbides, which have better inherent resistance to nitridation. (auth)

24728 (N-67-13671) INTERMOLECULAR BONDING OF VARIOUS METALS AND ALLOYS BY THERMOCHEMICAL VAPOR DEPOSITION. Final Report, April 15, 1965-October 31, 1966. Wilson, R. (Martin Co., Orlando, Fla.). Nov. 1966. Contract NAS8-20096. 145p. (NASA-CR-80721; OR-8580). CFSTI.

A four-phase program was directed toward the intermolecular bonding of various metals and alloys by thermochemical vapor deposition (TCVD) at temperatures below the recrystallization point. The four phases were: joining Al alloy 2219-T87 with TCVD Al; joining stainless steel alloy 321 with TCVD-N-Fe-C alloys; joining Ti alloy 8Mo-IV-1Co from the TCVD of inorganic or organic compounds; and joining Be alloys from TCVD of suitable inorganic or organic compounds. Described are TCVD plating compound characteristics; environmental control; substrate material, joint geometry, and heating; and carbonyl vapor generation, flow, and control. Results indicate that the thermochemical vapor deposition joining of Al, stainless steel, and Ti is feasible; high quality TCVD deposits of Al and Ni-Fe-C alloys were found to be suitable as coatings. (STAR)

24729 (NP-16732) [SOLID SOLUTION STRENGTHENED, HIGH PURITY BERYLLIUM ALLOY SHEET]. Bi-Monthly Progress Report No. 5, February-March 1966. Denny, John P. (Beryllium Corp., Reading, Pa.). Apr. 17, 1967. Contract NOw-66-0563-c. 12p.

Efforts devoted to development of solid solution strengthened high-purity Be alloy sheet are reported. Rolling and annealing to effect conversion from ingots to sheets were conducted during the period at 450, 600, and 800°F. Tensile data were obtained on material previously converted at 1200 to 1400°F, and bend tests were conducted. Sheet was successfully produced at all rolling temperature with the 0.008 and 1.0% Cu alloys exhibiting the best surface finish. Rolling procedures for 480, 600, and 800°F conversion consisted of encapsulation in Ni jacket, 5% reduction per pass, and one pass per reheat. Data are included from testing mechanical properties of alloy ingot sheet, and bend testing. (J.R.D.)

24730 (PEL-121(Vol.3), pp 268-307) THE PRODUCTION OF URANIUM METAL SPHERES. REPORT NO. 3 (FINAL). Geertsma, J. C.; Marran, J.; Jacobs, I. D. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

A description is given of the development and operation of a process to produce six hundred thousand uranium metal spheres each having a diameter of 10 mm. Costs for the cold-forging method were estimated at approximately $1.50/kg of spheres, but this figure does not include a full allowance for development work. (P.C.H.)

24731 (PEL-121(Vol.3), pp 312-26) URANIUM SPHERE CASTING. PRELIMINARY CALCULATIONS ON THE LEAD-SHOT TECHNIQUE FOR THE PRODUCTION OF URANIUM SPHERES. van Rensburg, A. J. J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)).

Preliminary calculations were made to determine the feasibility of applying the lead-shot technique to the production of uranium spheres. The terminal settling velocities of spheres in a fused-salt bath were determined from friction-factor data. The partial differential equations governing heat transfer accompanied by the liberation of latent heat were solved numerically on an IBM-1620 digital computer. The results established the feasibility of the lead-shot technique. (auth)

24732 (RFP-871) PLUTONIUM ELECTROREFINING AT ROCKY FLATS. Long, Jack L.; Schweikhardt, Robert D. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Apr. 17, 1967. Contract AT(29-1)-1106. 16p. Dep. CFSTI.

Development work at the Rocky Flats Plant in Pu electrorefining led to the completion of a practical six-cell facility. In addition, a new laboratory for research and development work on electrorefining and other high temperature processes has been completed. Process developments, including purification, efficiency, and mechanical improvements, are discussed. An electrorefining process-cost estimate predicts a figure of 9.7 direct man-hours per kilogram of Pu metal. This is thirty percent less than cost comparisons in aqueous processing. (auth)

24733 (UCRL-50172) HIGH-PRESSURE CONSOLIDATION OF SUBMICRON TUNGSTEN. Zima, Gordon E.; Lakner, John F. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 28, 1966. Contract W-7405-eng-48. 28p. Dep. CFSTI.

The production of ingots of sound macrostructure has enabled a quantitative densification analysis of submicron W using both belt and piston-cylinder high-pressure apparatus. Pressure, temperature, and time ranges are 0.4 to 35 kbar, 600 to 1400°C, 10 sec to 20 min, respectively. Under 23 kbar, 1170°C, and 10 min, sound ingots within 0.4% of theoretical density were obtained. A pressure survey at 1080°C and 10 min revealed a virtual densification equivalence of pressures ranging from 30 to approximately 1.4 kbar, with a sharp break in pressure influence occurring near 1 kbar. A density maximum near 1100°C has been correlated with the onset of grain growth under pressure. Over a mean particle size range of 0.25 to 7.0 μ ingot gas content appears to be the primary determinant of end-point density. Close agreement was obtained with theoretical end-point density predictions based on the plastic flow densification mechanism. Self-diffusion and activation-energy data calculated from 23-kbar processing agreed closely with data obtained from pressureless sintering. (auth)

24734 OBRABOTKA REZANIEM TUGOPLAVKIKH SPLAVOV (NA OSNOVE MOLIBDENA). (Machining of Refractory Alloys Based on Molybdenum). Zorev, N. N.; Fetisova, Z. M. Moscow, Izdatel'stvo Mashinostroenie, 1966. 227p.

Methods of machining refractory Mo alloys are discussed. A systematic description is given of the mechanisms of the effect of the machining conditions on the basic characteristics of the machining process. Specific recommendations are made on the conditions for individual machining processes. The role of adhesion and chemical resistance in instruments, the effect of the machining conditions on the stability of the instruments, and the effect of the medium on the stability are examined. (tr-auth)

24735 STUDY OF THE FABRICATION OF FUEL ELEMENTS FOR THE BR2 REACTOR FOR COEXTRUSION AND DRAWING. Flipot, A. J.; Massaux, H. (Centre d'Etudes de l'Energie Nucleaire, Mol-Donk, France). J. Nucl. Mater., 22: 177-91 (May 1967). (In French).

A method of fabricating nuclear fuel elements consisting of concentric layers was investigated and tested for the BR-2 reactor. The characteristics of an Al-24 wt % U alloy were examined and the influence of coextrusion and drawing parameters for the composite assembly was studied; this made it possible to establish accurately the ideal structure of the starting materials, the form of the billet and of its constituting elements and the fabrication method. Destructive and nondestructive testing techniques are surveyed. The results confirmed the quality of coextruded concentric tubes and the interest inherent in the production method. (auth)

24736 CASTING OF ZIRCALOY-URANIUM CORES FOR HWCTR DRIVER TUBES. Richmond, William J.; Isserow, Saul (Whittaker Corp., West Concord, Mass.). Nucl. Appl., 3: 294-7 (May 1967).

In the preparation of uranium fuel cores for a new set of driver tubes for HWCTR, the casting procedure required attention to the following: Zircaloy charged in discrete sections that permit drainage of melting metal; a heating schedule that minimizes contact of molten metal with the graphite crucible; and a mold design that effects directional solidification while minimizing the volume of scrap. (auth)

24737 ALUMINUM COATING OF URANIUM REACTOR PARTS FOR CORROSION PROTECTION. Mattox, D. M.; Bland,

R. D. (Sandia Lab., Albuquerque, N. Mex.). J. Nucl. Mater., 21: 349-52(Mar. 1967).

Ion plating deposition was used to provide an aluminum coating that gave good corrosion protection to bare uranium surfaces in an atmospheric environment. As a result of plating the fuel assembly of the Sandia Pulse Reactor (SPR), an alpha-contamination problem was eliminated. The conversion of the aluminum coating into UAl_3 by heating in vacuum to 600°C for 30 min further improved the corrosion resistance of the plating. (J.G.B.)

24738 FURNACE BRAZING INCONEL 718 FOR NUCLEAR REACTORS. Marti-Balaguer, Leopoldo; Rinker, Marshall E. (Westinghouse Electric Corp., Pittsburgh). Metal Progr., 91: No. 5, 113(May 1967).

A nickel-base filler metal in a vacuum of 5×10^{-4} torr or a H_2-atmosphere (−80°F dew point) produced 196 strong brazed joints in Inconel 718 fuel grids. (auth)

24739 ACTIVITY IN THE DEPARTMENT OF METALLURGY AND FUEL ELEMENT DEVELOPMENT OF THE EURATOM RESEARCH CENTER AT ISPRA. Moranville, C.; Schleicher, H. W. (EURATOM, Ispra, Italy). Neue Tech., 8: 341-9(Dec. 1966). (In German).

The activity of EURATOM's research center at Ispra in the field of metallurgy and fuel element development is reviewed. The work carried out on fuels, canning materials, compatibility, irradiations, and fuel element fabrication is briefly described. (auth)

24740 OXIDATION CHARACTERISTICS OF THE LANTHANIDE SERIES ELEMENTS. Hodge, Frank Galen. Troy, N. Y., Rensselaer Polytechnic Inst., 1965. 51p.

Thesis.

Dry oxidation experiments were performed on all the elements of the rare earth or lanthanide series elements plus Y with the exception of Pm. The oxidation rate behavior for all the metals was characterized. Experiments were conducted in moist air to determine the effect of moisture on the oxidation rates and kinetics. Qualitative correlations between oxidation rates and aqueous conditions of the surfaces were made, and these surfaces maintained constant characteristics over all of the area-to-volume changes. (Dissertation Abstr.)

24741 HEAT TREATMENT OF PLUTONIUM. Nelson, Ronald D. (to U. S. Atomic Energy Commission). U. S. Patent 3,317,355. May 2, 1967.

A process of treating Pu metal is described. Heating the Pu to above 650°C whereby it melts, casting the molten Pu into the shape desired, allowing the Pu shape to cool to 110 and 95°C, immersing the Pu shape in a liquid quenching bath having the temperature of between −75° and −115°C., and holding the Pu shape at this temperature for 10 to 15 minutes is the process given. (auth)

24742 NIOBIUM-SILICON BRAZING ALLOY FOR REFRACTORY METALS. Marshall, J. C.; Mueller, R. H. (to U. S. Atomic Energy Commission). U. S. Patent 3,317,288. May 2, 1967.

A brazing alloy for joining Ta, Nb, and alloys is described. The brazing alloy consists of 0.5 to 7.0 weight per cent Si and the remainder Nb. (auth)

24743 PROCESS FOR TREATING BERYLLIUM. (to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques). British Patent 1,068,545. May 10, 1967. Priority date Sept. 6, 1963, France.

A process is described for treating Be to produce spheroidal grains having reduced halogen content. The process comprises passing Be powder through a vertical furnace maintained at 1500 to 1800°C using an inert atmosphere at 0.1 to 0.9 bar. (J.R.D.)

24744 IMPROVEMENTS IN OR RELATING TO THE CASTING OF METALS. Willan, Ronald Robert; Duxbury, Donald (to United Kingdom Atomic Energy Authority). British Patent 1,068,291. May 10, 1967. Filed Jan. 22, 1963.

A method of reducing and casting metal is described. The metal is reduced in liquid state at the base of a containing vessel designed to include an orifice at its bottom which is plugged by metal similar to that being reduced. The plug is melted by the collected fused metal in the container but the time required for it to melt is sufficient to effect separation of slag and other inclusions from the collected fused metal. When the plug melts the fused metal flows into a casting mold. (J.R.D.)

24745 IMPROVEMENTS IN OR RELATING TO URANIUM ALLOYS. (to Compagnie pour l'Etude et la Realisation de Combustibles Atomiques). British Patent 1,068,286. May 10, 1967. Priority date July 1, 1964, France.

Improved radioresistant U alloys for use as fuel are described. The U-base alloys contain Cr−Ge−Zr additions totaling no more than 0.5 wt %. These alloys are stable under irradiation and are characterized by fineness of structure. (J.R.D.)

Properties Evaluations

Refer also to abstracts 23865, 24727, and 24801.

24746 (CEA-R-3152) ETUDES PRELIMINAIRES SUR LES ALLIAGES A BASE DE VANADIUM ENVISAGES POUR LA FABRICATION DE GAINES DE REACTEURS RAPIDES. (Preliminary Studies of Vanadium-Base Alloys Intended for Use in Fabrication of Cans for Fast Reactors). Conte, Madeleine (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1967. 65p. (In French). (EUR-3420.f). Dep.

Preliminary research has been carried out on a series of V-based alloys: V−0.5% Si; V−5% Ca; V−5% Mo; V−5% Nb; V−2% Zr; V−20% Ti; V−10% Al; V−10% Sn; and V−10% Ti for use as canning material in fast reactors. Transformation by forging at about 1000°C and rolling between 200°C and room temperature was satisfactory for all types of alloys except V−10% Sn and V−10% Al. The mechanical properties deduced from tensile strength tests carried out on alloy samples annealed 1 hour at 1050°C in a vacuum showed that, generally speaking, the addition elements led to an improvement in these properties as compared to those of pure V. After undergoing corrosion tests in a liquid Na loop purified by a cold trap, the alloys became brittle at room temperature. Only the V containing 20% Ti kept its plastic properties. These alloys were covered by a layer of VC. After undergoing treatment in a liquid Na loop purified by a hot trap, all the alloys kept their good mechanical characteristics. The surface layer with which they were covered was composed of two V carbides, VC and γVC, and a V sub-oxide, $VO_{0.9}$. (auth)

24747 (JINR-P03-3216) LOKAL'NYE KOLEBANIYA V SPLAVAKH Li−Mg I Be−Cu. (Local Modes in Li−Mg and Be−Cu Alloys). Natkanets, I.; Parlin'ski, K.; Baiorek, A.; Sudnik-Khrynkevich, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1967. 9p. (In Russian). Dep. mn.

Inelastic neutron scattering experiments with the alloys $Li_{0.05}-Mg_{0.95}$, $Li_{0.10}-Mg_{0.90}$, $Be_{0.02}-Cu_{0.98}$, and $Be_{0.05}-Cu_{0.95}$ and the pure metals, Mg and Cu, revealed vibrations of the impurity Li atoms in the Mg lattice of an energy of (35 ± 2) MeV and the Be atoms in the Cu lattice of an energy of (42 ± 2) MeV. The energy of these local modes for these systems, calculated with the assumption that the force constants in the vicinity of the impurity atom remain unchanged, equals 43 MeV (Li−Mg) and approximately 58 MeV (Be−Cu), respectively. It was estimated on the basis of the measured energies of local modes that the average change of the force constants of the impurity atom is approximately 45% for Li−Mg and 56% for Be−Cu. (auth)

24748 (N-67-11737) STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS. Brentnall, W. D.; Klein, Mark J.; Metcalfe, A. G. (Solar, San Diego, Calif.). Oct. 1966. Contract NAS7-469. 24p. (NASA-CR-79546; RDR-1534-1). CFSTI $3.00 cy, $0.65 mn.

The changes in mechanical properties and structure that occur in dispersion strengthened Nb-base alloys induced by loss of interstitials to more reactive metal coatings are discussed. The materials necessary for this investigation (Nb752 and D43) have been procured, analyzed chemically, and studied metallographically. A high-temperature vacuum creep facility is being constructed. (auth)

24749 (N-67-14209) MECHANISMS OF STRENGTHENING AND FRACTURE IN COMPOSITE MATERIALS. Fifth Progress Report, June 1-November 30, 1966. Tetelman, A. S. (Stanford Univ., Calif. Dept. of Materials Science). Nov. 30, 1966. 7p. (NASA-CR-80834; PR-5). CFSTI.

Research activities performed during this period included investigations of the effect of drilled holes on the notch toughness of iron base alloys; fracture mechanisms in quenched and tempered steel; elastic properties, strength levels, and fracture mechanisms in TiC−Ni−Mo cermets; problems involving stress concentrations in two phase composite materials using the method of continuously distributed dislocations; and the behavior of elastic-plastic cracks in a two phase system. (STAR)

24750 (UCRL-50207) EFFECT OF THERMAL HISTORY ON COMPOSITION CHANGES AND HARDNESS IN A MARAGING STEEL. Goldberg, Alfred (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 6, 1967. Contract W-7405-eng-48. 35p. Dep. CFSTI.

The influence of thermal history on the transformation behavior in a 300-grade 18%-Ni maraging steel was investigated. An im-

portant aspect of this study, which is based mainly on dilatometry, was to show that extensive microsegregation can develop in a maraging steel subjected to thermal cycling. The dilatometric studies were supplemented by microscopy, x-ray diffraction, hardness measurements, and magnetic permeability measurements. The dilatometric curves suggest that, as a result of prior thermal treatment, large changes in the temperature ranges of both the A (austenite) → M (martensite) and M → A transformations can occur. These changes are due to the microsegregation that had developed during the prior heating. This microsegregation largely originates during the process of precipitation that precedes the M → A reversion. On heating, precipitates form that are rich in elements which, when dissolved in A, depress the M_s (martensite-start temperature). The A that first forms during the M → A reversion is initiated largely at these precipitates and, as such, has a relatively low M_s. On the other hand, in the formation of these precipitates, much of the martensitic matrix becomes depleted of those elements which have combined as precipitates. Consequently, the A that subsequently forms from this M is depleted in these elements and, accordingly, has a relatively high M_s. When both austenites are present the A → M transformation can occur over quite a wide temperature range, which may still be incomplete at liquid nitrogen temperature. The extent to which microsegregation can develop and the effect of such segregation on the A → M and M → A reactions depends on the prior heating rate, the maximum temperature reached, the time at maximum temperature, and the number of thermal cycles. The development of segregation in the alloy can drastically reduce the as-aged hardness. (auth)

24751 THE EFFECT OF TEMPERATURE ON THE HARDNESS ANISOTROPY OF BERYLLIUM SINGLE CRYSTALS. Tsuya, K. (National Research Inst. for Metals, Tokyo). J. Nucl. Mater., 22: 148-57(May 1967).

The effect of orientation on hardness of Be single crystals, in the range from room temperature to 400°C, was studied using Knoop and Vickers indenters. The variation of Knoop hardness anisotropy with temperature is related to the alteration of deformation modes. The asymmetry of Vickers impression is explained on the basis of deformation around impressions. There is good agreement between the deformation markings around impressions and the orientation factors for each deformation system. (auth)

24752 THE EFFECT OF HYDROGEN AND STRAIN RATE ON THE "DUCTILE-BRITTLE" BEHAVIOR OF ZIRCALOY. Fearnehough, G. D.; Cowan, A. (United Kingdom Atomic Energy Authority, Lancs, Eng.). J. Nucl. Mater., 22: 137-47(May 1967).

Tests were made on hydrided and nonhydrided Zircaloy Charpy specimens in slow bend and also at impact rates of strain using an instrumented impact machine. Dynamic and static yield stresses were determined over a wide temperature range and it was concluded that different mechanisms control yielding at the two strain rates. The strain rate sensitivity of the yield stress was accompanied by a strain rate sensitivity of the "ductile-brittle" transition. The energy absorbed by nonhydrided Zircaloy specimens was increased by testing at high strain rates, whereas hydrided Zircaloy was considerably embrittled by increasing the strain rate. (auth)

24753 DECOMPOSITION OF TUNGSTEN–CHROMIUM SOLID SOLUTION. Porter, D. E. (Univ. of California, Berkeley). Contract W-7405-eng-48. Acta Met., 15: 721-6(May 1967). (UCRL-16619(Rev.)).

The mechanism of solid solution decomposition within the chemical spinodal boundary was investigated for the W–Cr system. Two alloys were solution treated, quenched, and aged at various temperatures inside the chemical spinodal boundary. It was concluded from x-ray and metallographic evidence that W–Cr alloys do not decompose by a spinodal mechanism. The decomposition process was found to be one of nucleation and growth. This observation is in agreement with Cahn's theory of the effect of strain energy on the spinodal decomposition. (auth)

24754 DIFFUSION OF XENON IN COPPER. Kawasaki, S. (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Mater., 22: 192-6(May 1967).

Xe was introduced into Cu specimens as a recoil fission product. Distribution in the specimens was measured both initially and after various annealing treatments. Comparison of measured distributions with those obtained by solving Fick's second diffusion equation provided a basis for calculating the diffusion coefficient of Xe in Cu. At 1000°C the coefficient was between 1×10^{-14} and 2×10^{-14} cm^2/sec, and at 950°C it was between 3×10^{-15} and 8×10^{-15} cm^2/sec. (auth)

24755 SUPERCONDUCTIVITY IN DEFORMED NIOBIUM ALLOYS. Narlikar, A. V.; Dew-Hughes, D. (Univ. of Lancaster, Eng.). J. Mater. Sci., 1: 317-35(Nov. 1966).

Determination of the role of dislocations in 3 high-field superconducting materials are discussed. Of these, the intermetallic compound Nb_3Sn is brittle and cannot be deformed. The other 2 are the alloys Nb–Zr and Nb–Ti, and their superconducting properties, in particular current-carrying capacity, are vastly enhanced by cold-work. A review of deformation structure in these metals is given and the main features of type II superconductivity are summarized. Their microstructure and superconducting properties were studied and compared with those of pure Nb. All 3 alloys are type II superconductors, which above a certain critical field, H_{c_1}, enter the mixed state, consisting of Abrikosov current vortices in a superconducting matrix. Dislocations introduced by deformation interact with current vortices to cause irreversible superconducting behavior and contribute to a high current-carrying capacity. It was concluded that a strong vortex dislocation interaction is obtained only when a non-uniform dislocation distribution is present, and that a uniform distribution produces only weak pinning. Flux-pinning by dislocation tangles is treated as a special case of pinning by normal particles resulting from a variation in κ, the Ginzburg–Landau parameter. (BBB)

24756 ETCHING RATE OF AN ION-BOMBARDED TUNGSTEN (110) SURFACE. Anderson, G. S. (Litton Systems, Inc., Minneapolis). J. Appl. Phys., 38: 1989-91(Mar. 15, 1967).

A radioactive tracer technique (^{85}Kr) was used to determine the etch rate of a W(110) surface as a function of depth. After bombarding with ^{85}Kr ions, one part of the target was used for determining the penetration depth distribution of embedded ions. The other part of the target was chemically etched for various times, and after each etching the target activity was measured. The depth distribution for embedded ions was used to determine the amount of material which had been etched away. A straightforward calculation was made to give the etch rate vs. depth. (W.D.M.)

24757 NEW A-15 PHASES. Vielhaber, E.; Luo, H.-L. (Univ. of California, San Diego, La Jolla). Solid State Commun., 5: 221-3(Apr. 1967).

The lattice parameters and the x-ray intensity data of two new A-15 compounds (Ti_4Tl and Zr_4Tl) are reported. In connection with searching for possible superconducting transitions in these compounds, four other compounds (V_3Pd, Ti_3Au, Ti_3Hg, and Zr_3Hg) were reinvestigated. All six compounds remained nonsuperconducting down to 0.35°K. (auth)

24758 DEFORMATION CHARACTERISTICS OF POLYCRYSTALLINE THORIUM FROM 78° TO 473° K. Zerwekh, R. P.; Scott, T. E. (Ames Lab., Iowa). Contract W-7405-eng-82. Trans. Met. Soc. AIME, 239: 432-7(Apr. 1967). (IS-1440).

The characteristics of deformation of ffc Th were examined between 78 and 473°K. Activation energy, activation volume, and the temperature dependence of the flow stress were determined and compared with several theories for the rate-controlling mechanism of the temperature-dependent component of the flow stress. It was established that the Cottrell–Stokes law does not hold, even approximately, for Th. Through consideration of the above factors and other parameters, it was concluded that the random solute barrier theory proposed by Friedel demonstrates the best agreement with experimental observations of the deformation of Th below ambient temperature. (auth)

24759 MICROYIELD STRENGTH OF BERYLLIUM–IRON ALLOYS. Argon, A. S.; East, G. (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME, 239: 598-9(Apr. 1967).

Microyield experiments in Be–Fe alloys with wt % composition up to 2% are described. Results indicate that considerable solution-hardening can be obtained in Be with the introduction of 0.5 to 2.0% Fe. The absence of yield phenomena suggests that no dislocation locking is involved the observed hardening. Reason for this unexpected hardening seems to lie with the extremely small strain, which results from the bulging of dislocation through precipitates. (P.C.S.)

24760 ELASTIC ANISOTROPY OF ROLLED BERYLLIUM. Moment, R. L. (Dow Chemical Co., Golden, Colo.). Trans. Met. Soc. AIME, 239: 542-6(Apr. 1967).

The anisotropic elastic behavior of rolled Be sheet was measured, using a pulse echo technique, and compared with x-ray diffraction data. Calculated elastic stiffness constants compared favorably with published values for Be single crystals, which were attributed to the strong (0002) rolling plane texture. Variations of Young's modulus in the rolling plane could be associated with the relative distribution of (0002) planes out of their ideal position in the rolling plane. (auth)

24761 SURFACE LAYER EFFECTS ON THE PLASTIC DEFORMATION OF IRON AND MOLYBDENUM. Kramer, I. R. (Martin Marietta Corp., Baltimore). Trans. Met. Soc. AIME, 239: 520-8(Apr. 1967).

The stress associated with the surface layer was determined for Fe and Mo. Measurements show that the surface layer plays a very important role in the plastic deformation of bcc metals. From the relation between strain and surface-layer stress and the back stress imposed by the internal obstacles, it is proposed that the term σ_f^0 of the Hall–Petch equation ($\sigma_f = \sigma_f^0 + Kd^{-\frac{1}{2}}$) is related only to the surface stress while the term $K_f d^{-\frac{1}{2}}$ is the stress required to move dislocations through internal obstacles. Further, it was possible to derive the well-known empirical equation $\bar{\sigma} = a\bar{\epsilon}^n$, and it is shown that the term a is comprised of two terms: a term C_s associated with the surface layer stress and C_i related to internal dislocation obstacles. (auth)

24762 THE EFFECT OF PREFERRED ORIENTATION ON THE MECHANICAL PROPERTIES AND DEFORMATION BEHAVIOR OF ZIRCALOY-2 FUEL SHEATHING. Steward, K. P. (Solar, San Diego, Calif.); Cheadle, B. A. Trans. Met. Soc. AIME, 239: 504-13(Apr. 1967).

Axial tensile, ring tensile, closed-end burst, and free-end burst tests were done at room temperature and 300°C on three batches of Zircaloy-2 sheathing with different textures. Knoop hardness tests were also done on all batches. The mechanical properties of the tubes were largely dependent on the percentages of cold work, but were also markedly affected by the textures, particularly with respect to deformation behavior. The deformation behavior observed confirmed Picklesimer's predictions, whereas Knoop hardness results could be correlated with texture and yield strength anisotropy after the method of Wheeler and Ireland. From the mechanical properties, and from effective strain values determined at the fractures using a photogrid technique, it was concluded that tubing with a single preferred orientation of radial basal poles best combines strength and ductility for any given degree of cold work. (auth)

24763 HYDROGEN IN BERYLLIUM. Jones, P. M. S.; Gibson, R. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Nucl. Mater., 21: 353-4(Mar. 1967).

The beryllium–hydrogen system was studied using tritium instead of hydrogen since small quantities can be measured easily using ion chambers. The tritium release at any temperature followed the type of logarithmic equation expected for a diffusion controlled process. However, when the temperature was raised further, gas was evolved at some new limiting value, and this could be repeated at a series of temperatures. It was postulated that the tritium became trapped, possibly in molecular form, at sites with a range of energies such that only a fraction of the gas was available at any temperature. Diffusion and solubility constants were calculated. (J.G.B.)

24764 DIFFUSION OF THORIUM, PROTACTINIUM, AND URANIUM IN FACE-CENTRED CUBIC THORIUM. Schmitz, F.; Fock, M. (Technical Univ., Brunswick). J. Nucl. Mater., 21: 317-22(Mar. 1967).

Diffusion of ^{228}Th, ^{231}Pa and ^{233}U in polycrystalline α-thorium was measured in the temperature range 690 to 910°C by the nondestructive technique of alpha-spectrum degradation. A new electrolytic method with limed zirconia as solid electrolyte was applied to keep the surface of the diffusion specimens oxide-free during diffusion-annealing. The following temperature functions in Cm^2/sec were obtained: $D_{Th} = 3.95 \times 10^2 \exp(-71.600/RT)$; $D_{Pa} = 1.26 \times 10^2 \exp(-74.700/RT)$; and $D_U = 2.21 \times 10^4 \exp(-79.300/RT)$. The value for thorium self-diffusion obeys empirical rules for vacancy diffusion in fcc metals. (auth)

24765 THEORY OF HYDROSTATIC EXTRUSION OF BRITTLE METALS. Kolmogorov, V. L.; Ural'skii, V. I.; Kozlov, G. D. (Ural Scientific-Research Inst. of Ferrous Metallurgy, Sverdlovsk, USSR). Fiz. Metal. Metalloved., 23: 170-3(Jan. 1967). (In Russian).

The plasticity Λ_p (degree of shear deformation at moment of fracture) of metals depends on their indicator σ/T of stressed state (where σ is the mean hydrostatic pressure and T is the intensity of shear stresses), as has been established for Mo, Zn, Be, and W. An analysis was made of the pertinent plasticity diagrams for Mo, Zn, Be, and W, taken from Pugh (NEL Report no. 142, March 1964) and others. It was concluded that there exists a certain critical stressed state $(\sigma/T)_{cr.\,1}$ at which transition from the plastic to brittle state or vice versa takes place. It is possible to assume the existence of a second characteristic indicator $(\sigma/T)_{cr.\,2}$ at which transition of the metal to a state of unlimited plasticity takes place; then deformation is not accompanied by any loss of plasticity. The variation in Λ_p as a function of the indicator of stressed state differs sharply for different metals. Thus for Be Λ_p increases slowly with decrease in σ/T. The growth rate of Λ_p for Mo and W is roughly the same, but Mo is much more plastic. Thus at zero σ/T (torsion, pure shear, etc.) Mo may undergo deformation with 68% reduction in cross sectional area while W is absolutely nonplastic. The plastic deformation of a metal is feasible if the metal's $(\sigma/T)_{cr.\,1}$ exceeds its σ/T. If this condition is satisfied and σ/T is not smaller than $(\sigma/T)_{cr.\,2}$, the deformation of the metal is possible only up to a point; in all cases the degree of deformation must be lower than the limiting Λ_p which leads to fracture. A formula is derived for the utilizable plasticity margin of metals. In this connection, the possibilities of hydrostatic extrusion (without counter-pressure) are considered for Mo, Zn, Be, and W. An analysis of stressed state reveals that extrusion of this kind is feasible for Mo and Be since the critical indicator of transition to brittle state is much higher (–0.94) for these two metals. The pressing of Zn and particularly W (considering certain fluctuations in plasticity) is difficult to accomplish, in view of the high likelihood of cracking of the products. (ATD)

24766 DEFORMATION PROPERTIES OF NIOBIUM SINGLE CRYSTALS. Bowen, D. K.; Christian, J. W.; Taylor, G. (Oxford Univ.). Can. J. Phys., 45: 903-38(Feb. 1967).

Vacuum-purified Nb crystals of various orientations were tested in tension and compression, mainly at room temperature and 158°K. The observed slip planes were almost always of the {101} or {211} type, and the asymmetry of the stress for slip on {211} was confirmed at both temperatures. The critical resolved shear stress was approximately constant at room temperature, but a strong orientation dependence of both the macroyield and the microyield stress was found at 158°K. Three-stage work-hardening curves were found for both the {101} and {211} single-slip orientations at room temperature; there was also a pronounced stage 0 and large overshoot for {101} slip, but not for {211} slip. Dislocation distributions in stage I consisted mainly of long slip-plane clusters containing edge dislocations, and in stage II complex, densely packed obstacles built up into a cell structure. The secondary dislocation density was very high in stage II. After deformation at 158°K, the structure contained a fairly uniform distribution of screw dislocations and small loops. Current ideas on the effects of impurities, the origin of the friction stress, the significance of asymmetry, and the orientation dependence are reviewed. (auth)

24767 MECHANICAL PROPERTIES OF SOME TANTALUM ALLOYS. Mitchell, T. E.; Raffo, P. L. (Case Inst. of Tech., Cleveland). Can. J. Phys., 45: 1047-62(Feb. 1967).

The mechanical properties of a series of Ta–Re alloys and some Ta–Mo and Ta–W alloys were investigated by deforming single crystals in compression. Experimental results on slip-line observations, stress–strain curves, yield stresses, and anisotropic elastic constants are presented. Slip occurred on the {110} planes; twinning was never observed and the alloys became increasingly brittle as the solute concentration increased or the temperature decreased. Yield stress versus composition curves showed a minimum at low temperatures. It is suggested that this is due to a reduction in the intrinsic lattice friction stress of the pure metal by alloying, before alloy hardening is able to increase the yield stress again. The alloy hardening was analyzed and the yield stress τ, the solute concentration c, and the temperature T are related by an expression $(\tau/k\mu c^{\frac{1}{2}})^{\frac{1}{2}} = 1 - (T/T_0)^{\frac{1}{2}}$, where k and T_0 are constants and μ is the shear modulus. Such a relation was derived by Fleischer for interactions of dislocations with tetragonal distortions. It is unlikely that this implies that tetragonal defects (i.e., solute pairs) are important in Ta alloys; presumably elastic interactions with single solute atoms can also give such a temperature and concentration dependence of the yield stress. Comparisons with other bcc alloys were made and it is found that the rate of alloy hardening is directly proportional to the atomic size misfit in most of the alloys where data are available for single crystals. (auth)
crystals. (auth)

24768 EFFECT OF ORIENTATION AND IMPURITIES ON THE MECHANICAL PROPERTIES OF MOLYBDENUM SINGLE CRYSTALS. Stein, D. F. (General Electric Co., Schenectady, N. Y.). Can. J. Phys., 45: 1063-74(Feb. 1967).

Mo single crystals containing less than 10 ppM of C, 5 ppM of N, and 5 ppM of O were prepared by zone melting and H_2 gas purification. The mechanical properties of the crystals were measured in tension and compression over a range of temperature from 20 to 298°K. It was found that the critical resolved shear stress (CRSS) and the temperature dependence of the CRSS decreased with increasing purity. It was found that at all test temperatures the CRSS law fails. The CRSS is a minimum in the (100) tension axis orientation and reaches a maximum with the tensile axis along the (110)(111) line of the stereographic triangle. It was also found that the ductility of Mo single crystals was not improved by purification. (auth)

24769 PLASTIC ANISOTROPY OF TANTALUM, NIOBIUM, AND MOLYBDENUM. Sherwood, P. J.; Guiu, F.; Kim, H. C.;

Pratt, P. L. (Imperial Coll. of Science and Tech., London). Can. J. Phys., 45: 1075-89(Feb. 1967).

The stress–strain behavior of single crystals of Ta, Nb, and Mo was studied in both tension and compression in the temperature range 4.2 to 400°K. The crystals were stressed in both the ⟨100⟩ and the ⟨110⟩ directions. At high temperatures, the yield stress of all three metals is independent of the direction and sense of the applied stress. At low temperatures, the yield stress depends markedly on the orientation of the crystals and the sense of the applied stress. This anisotropic behavior cannot be satisfactorily explained in terms of any of the mechanisms proposed so far, such as the mobility of jogs in screw dislocations, or the dissociation of a/2 ⟨111⟩ screw dislocations on {112} planes. (auth)

24770 ORIENTATION DEPENDENCE OF YIELD IN BODY-CENTERED CUBIC METALS. Hull, D.; Byron, J. F.; Noble, F. W. (Univ. of Liverpool, Eng.). Can. J. Phys., 45: 1091-9 (Feb. 1967).

Observations relating to the critical resolved shear stress for slip in Ta and W are reported. The results of tensile and compressive deformation are discussed in terms of the operative slip systems and the possible asymmetry of {112}⟨111⟩ slip. It was concluded that the asymmetry hypothesis is unable to account satisfactorily for anomalies in the deformation behavior of these materials. (auth)

24771 MICROSTRAIN BEHAVIOR OF BODY-CENTERED CUBIC METALS. Meakin, J. D. (Franklin Inst. Research Labs., Philadelphia). Can. J. Phys., 45: 1121-34(Feb. 1967).

The true elastic limit of high-purity Mo, W, and Fe is shown to be of the order of $10^{-5}\ \mu$, where μ is the shear modulus. At higher stresses, linear reversible deformation occurs up to total strains of the order 10^{-3}. The strain-rate sensitivity of the flow stress in this region was investigated and a possible rate controlling dislocation mechanism is discussed. (auth)

24772 INVESTIGATIONS ON SOME DEFORMATION MODES OF BERYLLIUM. Poirier, J. P.; Antolin, J.; Dupouy, J. M. (CEN de Saclay, Gif-sur-Yvette, France). Can. J. Phys., 45: 1221-4(Feb. 1967).

Single crystals of Be compressed along the c axis, above 400°C, undergo a deformation that can be ascribed to the climb of c dislocation loops possibly created by Bardeen–Herring sources. Observation of twins gave evidence supporting the theory of twinning by dislocations. Also, numerous stacking faults were found in twins, resulting from the condensation of vacancies created during twinning. (auth)

24773 MAGNETIC STRUCTURE OF THE INTERMETALLIC COMPOUNDS $CeCo_5$ AND $TbCo_5$. Lemaire, R.; Schweizer, J. (Centre d'Etudes Nucleaires, Grenoble, France). J. Phys. (Paris), 28: 216-20(Feb. 1967). (In French).

The intermetallic compounds $CeCo_5$ and $TbCo_5$ have been studied by neutron diffraction. In the compound $CeCo_5$ the magnetic moment of the Ce atom is less than 0.3 μB. Magnetic moments of the five Co atoms are ferromagnetically coupled and are parallel to the c axis. In the compound $TbCo_5$ the magnetic moment of the Tb atom is antiparallel to those of the Co atoms. The moments are along the a axis below 365°K and along the c axis above 450°K. Between these two temperatures the magnetization axis rotates continuously. This rotation explains the anomaly on the magnetization curves versus temperature under constant fields. The Co atoms of the two crystallographic sites of this compound have slightly different magnetic moments. (auth)

24774 HIGH-TEMPERATURE MATERIALS IN MODERN TECHNIQUE AND METHODS OF DETERMINING THEIR THERMAL PROPERTIES AT TEMPERATURES UP TO 3500°C. Tyukaev, V. I.; Shashkov, A. G. (Inst. of Thermal and Mass Exchange, Minsk). Inzh.-Fiz. Zh., 12: 263-77(Feb. 1967). (In Russian).

A brief review is given of uses of high-temperature materials and of methods for determining the thermophysical properties of materials at temperatures up to 3600°C. Properties of materials for construction of fuel-element casings for liquid-metal-cooled reactors and rocket building materials are discussed. Designs are given for: devices for measuring the heat capacity up to 3600°C; a tubular graphite furnace for determining heat capacity up to 3600°C and devices for determining the enthalpy, heat capacity, and heat conductivity up to 2500 and 2700°C. A method is given for computing heat-effects on carbonization of heat-protective plastics. Forty-two references are included. (R.V.J.)

24775 DIFFUSION IN BODY-CENTERED CUBIC METALS. Papers Presented at the International Conference, Gatlinburg, Tennessee, September 16 to 18, 1964. Metals Park, Ohio, American Society for Metals, 1965. 437p. (CONF-691).

The conference proceedings include 27 papers divided into 5 sections, introduction and survey of experimental work, lattice dynamics, diffusion by stress relaxation methods, chemical and tracer diffusion, and enhancement of diffusion. A discussion of the papers is presented in a 6th part. Abstracts were prepared for 7 papers. Two papers were abstracted previously; see NSA 19: 16200 and 19: 23112. (B.L.M.)

For abstracts of individual papers see: 23865, 24776–24778, and 24808–24810.

24776 SUMMARY OF ORNL WORK ON DIFFUSION IN BETA ZIRCONIUM, VANADIUM, COLUMBIUM, AND TANTALUM. Lundy, T. S.; Federer, J. I.; Pawel, R. E.; Winslow, F. R. (Oak Ridge National Lab., Tenn.). pp 35-49 of Diffusion in Body-Centered Cubic Metals. Metals Park, Ohio, American Society for Metals, 1965.

Results of experiments performed over a 3 yr period using radioactive-tracer methods combined with mechanical suctioning techniques to determine activity profiles after samples were subjected to isothermal diffusion-annealing techniques are described. The diffusion coefficients in β-Zr, V, Nb, and Ta were measured over a wide temperature range, and deviations from Arrhenius behavior was noted in all instances. For Nb and Ta these deviations are explained in terms of short-circuiting. (B.L.M.)

24777 TRACER DIFFUSION IN GAMMA URANIUM. Rothman, S. J.; Peterson, N. L. (Argonne National Lab., Ill.). pp 183-96 of Diffusion in Body-Centered Cubic Metals. Metals Park, Ohio, American Society for Metals, 1965.

Results of experiments of tracer diffusion of other elements (impurity diffusion) in γ-U are presented. The U samples were cleaned by cathodic sputtering, and the radioactive tracers were deposited on them in thin layers by evaporation or sputtering. The diffusion of Cr, Mn, Fe, Co, Ni, Cu, Nb, and Au were studied, and Arrhenius plots are presented for these elements as well as for selfdiffusion in γ-U as measured by ^{235}U. The diffusion data indicate that γ-U is an "anomalous diffuser," but that the diffusion certainly takes place by a defect mechanism. (B.L.M.)

24778 MECHANISM OF DIFFUSION IN BETA ZIRCONIUM, BETA TITANIUM, AND GAMMA URANIUM. Kidson, G. V. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 329-47 of Diffusion in Body-Centered Cubic Metals. Metals Park, Ohio, American Society for Metals, 1965.

Discussion is presented of the nonlinear Arrhenius curves in β-Zr, β-Ti, and γ-U, and explanations are given for resolving the curves into two components, one representing the contribution of normal vacancy diffusion. Two alternative models were examined for the second component. One model is based on the postulate of enhanced vacancy concentration due to interstitially dissolved O, and the second model is based on enhanced diffusion along dislocations. No definite conclusions could be drawn about the diffusion behavior of these materials. (B.L.M.)

Structure and Phase Studies

Refer also to abstracts 24748, 24757, 24766, 24772, 25076, and 25189.

24779 (CEA-R-3062) ETUDE DES TRANSFORMATIONS ALLOTROPIQUES DU PLUTONIUM. (Study of Allotropic Transformations in Plutonium). Spriet, Bernard (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1966. 88p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

The allotropic transformations in Pu were studied by different methods: metallography, dilatometry, thermal analysis, resistivity measurements, and examination with a hot-stage microscope. In order to study the importance of the purity, purification processes such as zone-melting or electrodiffusion were developed. The characteristics of the $\alpha \rightleftharpoons \beta$ transformation can be explained in terms of the influence of internal stresses on the transition temperature and on the transformation kinetics. Some particular characteristics of $\delta \rightarrow \gamma$, $\gamma \rightarrow \alpha$, $\delta \rightleftharpoons \epsilon$, $\beta \rightleftharpoons \gamma$, and $\delta \rightarrow \alpha$ transformations are also given. (auth)

24780 (KAPL-3193) EXAGGERATED GRAIN GROWTH IN REACTOR-GRADE HAFNIUM AFTER SMALL DEFORMATIONS. Calhoun, C. D. (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 2, 1966. Contract W-31-109-eng-52. 28p. Dep. CFSTI.

Reactor-grade Hf was cold-rolled at 25°C to reductions of 2, 4, 6.5, 8.5, 10.5, and 12.5%. Samples from this material were heat-treated at 700, 800, 900, 950, and 1000°C for 10, 10^2, 10^3, and 10^4 min. Light microscopy was employed to study the microstructure for exaggerated grain growth. The relations between hardness and x-ray line-broadening as a function of cold-rolling up to 12.5% reduction in area were determined. Exaggerated grain

growth appeared to result from the growth of existing grains. An incubation period associated with the exaggerated grain growth varied inversely with cold work. In addition, the ultimate grain size increased with decreasing cold work. Exaggerated grain growth was absent in all heat-treatments at 700 and 800°C, for times of 10^4 min. In metal cold-worked 10.5% or greater, the increase in grain size was not appreciable for any of the heat-treatments employed. (auth)

24781 (SU-326-P17-1) PROGRESS REPORT [ON STRUCTURE DEPENDENCE OF VISCOUS DEFORMATION IN METALS AND ALLOYS], JUNE 1, 1966–MARCH 30, 1967. Barrett, Craig R.; Nix, William D. (Stanford Univ., Calif. Dept. of Materials Science). Mar. 30, 1967. Contract AT(04-3)-326. 21p. Dep. CFSTI.

Viscous creep tests were made on pure Al, Al–Fe, and SAP. Special attention was given to dislocation density and stacking fault energy, which directly affect the rate of viscous deformation. The effects of grain size and sample size were also considered, because of their importance in distinguishing between directed vacancy diffusion and dislocation climb. The results showed a linear dependence between creep rate and stress and also that the predominant deformation mechanisms are dislocation motion and grain boundary sliding or probably more accurately, enhanced deformation near grain boundaries. Reasons for this are given. To determine the stress dependence of dislocation density, ρ, during high temperature low stress creep, a series of tests were conducted on an Fe–3% Si alloy. The results demonstrated that if the stress dependence of ρ becomes very small at low stresses then the entire stress dependence of the creep rate should come from the dislocation velocity term, which at high temperatures and low stresses predicts a linear stress dependence. Studies are continuing. (P.C.H.)

24782 (UCRL-Trans-10088) PHASE DIAGRAM OF THE Mg–Mn SYSTEM. Petrov, D. A.; Mirgalovskaya, M. S.; Strel'nikova, I. A.; Komova, E. M. Translated by Z. F. St-Gallay for Univ. of California Lawrence Radiation Lab., Livermore, from Tr. Inst. Met. Im. A. A. Baikova, Akad. Nauk SSSR, No. 1, 142-3(1957). 5p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.10 fs, $0.80 mf.

The solubility of Mn in solid Mg was determined by analysis of the microstructure and by examining the properties of annealed alloys. The alloys were annealed for 5 to 25 days at 300, 400, 450, 500, 550, 600, and 630°C, and then quenched. The results were used to construct the phase diagram of the Mg–Mn system. It was found that the invariant three-phase reaction is of peritectic nature and occurs at 653°C. Extrapolation of the solubility curve to its intersection with the peritectic horizontal line showed that the maximum solubility is 2.3% of Mn. (P.C.H.)

24783 CRYSTALLINE STRUCTURE OF THE COMPOUND DyAl. Becle, Christian; Lemaire, Remy (Laboratoire d'Electrostatique et de Physique du Metal, Grenoble, France). Compt. Rend., Ser. B, 264: 543-5(Feb. 13, 1967). (In French).

The structure of DyAl is isomorphic with that of the compounds TAl (with T = Pr, Nd, Sm, Gd, Tb, Ho, Er, and Tm); it crystallizes in orthorhombic group Pbcm; and it can be described with trigonal motifs presenting an analogy with a CsCl semilattice cell. (tr-auth)

24784 THE KINETICS OF THE $\alpha \rightleftharpoons \beta$ TRANSFORMATIONS IN SOME DILUTE PLUTONIUM ALLOYS. Davy, L. G. T.; Faiers, M. E.; White, J. S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Nucl. Mater., 22: 197-204(May 1967).

An investigation was made of the kinetics of $\alpha \rightleftharpoons \beta$ transformations in unalloyed Pu, and dilute Pu alloys containing either Np or Ti. The solutes were chosen because Ti is known to stabilize the β phase whereas Np raises the $\alpha \rightleftharpoons \beta$ transition temperature and thus may be considered to stabilize the α phase. The results show that relative to unalloyed Pu, Ti retards the $\beta \rightarrow \alpha$ transformation but accelerates the $\alpha \rightarrow \beta$ transition. In contrast Np has exactly the opposite effect. It appears therefore that the greater the driving force for the transformation the faster the rate of reaction. (auth)

24785 HYSTERESIS IN THE $\alpha-\beta$ TRANSITION OF URANIUM SATURATED WITH SILICON. Benz, R.; Tinkle, M. C. (Los Alamos Scientific Lab., N. Mex.). J. Nucl. Mater., 22: 228-31 (May 1967). (LA-DC-8440).

Si additions to Si-saturated U are shown to increase the $\alpha-\beta$ hysteresis and decrease the U grain size. The hysteresis was observed to be appreciably greater in the system with the lowest concentration investigated, than that of the pure U and the hysteresis increased with Si content up to the highest concentration investigated, 0.53 wt % Si. (M.C.G.)

24786 DISLOCATION VELOCITY MEASUREMENTS AND THERMALLY ACTIVATED MOTION IN MOLYBDENUM. Prekel, H. L.; Conrad, H. (Franklin Inst. Research Labs., Philadelphia). Acta Met., 15: 955-8(May 1967).

It was demonstrated that dislocation velocities in Mo measured by the etch-pitting technique obey the equation, $v = v_0 (\tau/\tau_0)^m$ and that this equation can be derived directly from thermal activation theory—at least over the stress range where it was confirmed by experiment. Such magnitudes as the activation volume and kink energy calculated from the velocity measurements are discussed in terms of the thermally activated overcoming of the Peierls hills. Results indicate that the deformation dynamics in micro- and macro- strain regions in Mo in directly related to the thermally activated motion of individual dislocations. (J.G.B.)

24787 STRESS DEPENDENCE OF DISLOCATION CONFIGURATION IN DEFORMED NIOBIUM. Stiegler, J. O.; DuBose, C. K. H. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Acta Met., 15: 953-5(May 1967). (ORNL-P-2586).

An attempt was made to separate temperature and stress as deformation variables in the dislocation configuration of Nb. Dislocation substructures were compared in specimens strained ~2.5% in tension at a rate of 0.024/min at 23 and −68°C, with those in a specimen strained an equivalent amount at −68°C at a constant stress of 8400 psi. It was concluded that the dislocation substructure produced at a particular strain is a sensitive function of the stress path taken to obtain the strain. The different structures observed at constant temperature and varying stresses showed that dislocation behavior depends strongly on the applied stress. (J.G.B.)

24788 PHASE STABILITY AND STACKING FAULTS IN CERIUM ALLOYS. Clinard, Frank W. Jr. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Appl. Phys., 38: 1694-1700(Mar. 15, 1967). (LA-DC-8261).

Electrical resistivity and x-ray studies were performed on a series of cerium samples, each of which contained in solution a 2-at.% addition of one of the other rare earths (except promethium and ytterbium). The resistivity measurements showed that the amount of double hcp β phase formed at low temperatures varied in accord with the solute species present, the maximum amounts of β being associated with the solutes at the ends of the rare-earth series and the minimum with those near the center of the series. The anomalously strong β-forming tendency of the europium solute is explainable on the basis of atomic-size and valence effects. The x-ray studies revealed a varying tendency toward extrinsic stacking-fault formation, which correlates with the trend in β-phase formation. The correlation is attributed to the fact that both β cerium and extrinsic faults in fcc γ cerium exhibit ABAC stacking of close-packed planes. It is proposed that the observed trends in ABAC stacking stability are dependent on the number of unpaired 4f electrons of the solute atoms, with the stability being least when the number of these magnetic electrons is greatest. (auth)

24789 DISLOCATION MOBILITY AND MOTION UNDER COMBINED STRESSES. Baker, G. S.; Carpenter, S. H. (Aerojet-General Corp., Sacramento, Calif.). J. Appl. Phys., 38: 1586-91 (Mar. 15, 1967).

Measurements of dislocation damping as a function of static biasing stress and during deformation were carried out on single-crystal, high-purity tantalum. The results show that the dislocation mobility for small periodic stresses is orders of magnitude greater than for large constant stresses. The change in flow stress $\Delta\sigma$ due to the application of a small periodic stress σ_v is proportional to σ_v^2. This second-power dependence of $\Delta\sigma$ on σ_v is shown to result from thermal activation of the deformation. Calculations of activation energies and volumes using the point-defect theories of Gilman and Fleischer give reasonable values. The large difference in dislocation mobility between the periodic type motion and the unidirectional motion indicates that the thermal component of the flow stress is not due to a Peierls-type mechanism, but to discrete dispersed barriers to dislocation motion. (auth)

24790 THE ORIENTATION OF ZIRCONIUM HYDRIDE ON GRAIN BOUNDARIES IN ZIRCALOY-2. Arunachalam, V. S.; Lehtinen, B.; Oestberg, G. (Aktiebolaget Atomenergi, Stockholm). J. Nucl. Mater., 21: 241-8(Mar. 1967).

An electron microscopic investigation on the orientation relationships between grains having hydrides in their boundaries was carried out on Zircaloy-2. Apart from the basal plane, all other habit planes recorded by others were found to operate for the precipitation of zirconium hydride. For adjacent grains which were only mutually "rotated" (having the same normal in the direction of the electron beam), the same habit plane was found to operate for precipitation in both the grains. No hydride precipitates were observed on twin boundaries. Possible technical implications of the relationship between hydride orientation and texture are discussed. (auth)

24791 TRANSFORMATIONS AND STRUCTURES IN THE URANIUM–RHENIUM SYSTEM. III. FORMATION AND STRUCTURE OF δ (U_2Re). Jackson, R. J.; Larsen, W. L. (Ames Lab., Iowa). Contract W-7405-eng-42. J. Nucl. Mater., 21: 282-6(Mar. 1967). (IS-1393).

The δ (U_2Re) phase was formed via a sluggish peritectoid reaction. A single phase alloy of stoichiometric composition was obtained by a six-month treatment. The interplanar spacings and intensities are tabulated. The formation modes of U_2Re are discussed. Evidence is presented for a δ′ transition phase that is intermediate between the ordered γ_b^0 tetragonal phase and the stable δ phase. (auth)

24792 TRANSFORMATIONS AND STRUCTURES IN THE URANIUM–RHENIUM SYSTEM. II. THE $\beta \rightleftharpoons \alpha$ TRANSFORMATION. Jackson, R. J.; Larsen, W. L. (Ames Lab., Iowa). Contract W-7405-eng-42. J. Nucl. Mater., 21: 277-81(Mar. 1967). (IS-1392).

The compositions and cooling rates under which the β phase was rendered metastable are discussed. In addition, the stability of the retained β phase and its modes of decomposition are considered. The $\beta \rightarrow \alpha$ transformation was found to proceed via an isothermal martensitic reaction or by a sluggish nucleation and growth process. (auth)

24793 TRANSFORMATIONS AND STRUCTURES IN THE URANIUM–RHENIUM SYSTEM. I. METASTABLE α′, α″, AND γ^0 STRUCTURES. Jackson, R. J.; Larsen, W. L. (Ames Lab., Iowa). Contract W-7405-eng-42. J. Nucl. Mater., 21: 263-76 (Mar. 1967). (IS-1390).

The compositional limits within which the stable and metastable phases form, the effect of cooling rate and temperature on producing alternative structures, and the sequence of phase changes were determined. The metastable transition states observed were the orthorhombic α′, monoclinic α″, and tetragonal γ^0 phases. Arguments are presented to explain the observed crystal structures and microstructures and the effect of cooling rate and composition thereon. Finally, the relation between metastability in U–Re alloys and other systems in which metastable states are observed is discussed. (auth)

24794 PHASE RELATIONS AND THERMODYNAMIC PROPERTIES FOR THE SAMARIUM–ZINC SYSTEM. Chiotti, P.; Mason, J. T. (Ames Lab., Iowa). Contract W-7405-eng-42. Trans. Met. Soc. AIME, 239: 547-52(Apr. 1967). (IS-1432).

Thermal, x-ray, metallographic, and vapor pressure data were obtained to establish the phase diagram and standard free energy, enthalpy, and entropy of formation for the compounds in the Sm–Zn system. Four compounds, SmZn, $SmZn_2$, $SmZn_{4.5}$, and $SmZn_{6.5}$, melt congruently at 960, 942, 908, and 940°C, respectively. The compounds $SmZn_3$, Sm_3Zn_{11}, and $SmZn_{7.3}$ undergo peritectic decomposition at 855, 870, and 890°C, respectively. Another compound of uncertain stoichiometry, $SmZn_{11}$, undergoes peritectic decomposition at 760°C. Four eutectics were observed with the following compositions in wt % zinc: 12%, 680°C; 36%, 890°C; 58%, 850°C; and 72%, 900°C. An allotropic transformation and a composition range were observed for the $SmZn_2$ compound. The transformation varies from 905 to 865°C as the zinc content increases from 46.0 to 48.5 wt %, respectively. The free energy of formation of the compounds at 500°C varies between –15.9 kcal per mole for SmZn to –51.1 kcal per mole for $SmZn_{6.5}$. Corresponding enthalpies vary between –19.2 to –78.3 kcal per mole. The thermodynamic properties for the liquid alloys are described by the relations: $\Delta\overline{F}^{xs}_{Zn}/N^2_{Sm} = (-5000 - 6.49T) + (-162{,}500 + 94.16T)N^3_{Zn}$ and $\Delta\overline{F}^{xs}_{Sm}/N^2_{Zn} = (-5000 - 6.49T) + (-162{,}500 + 94.16T)N^3_{Zn}(N_{Zn} - 0.600)$. $\Delta\overline{F}^{xs}$, N, and T are the relative excess partial molal free energy, atom fraction, and temperature in °K, respectively. (auth)

24795 KRAUT–KENNEDY MELTING RELATIONSHIP AT HIGH PRESSURES EXTENDED TO CERTAIN PHASE TRANSFORMATIONS. Fischer, R. B. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. J. Nucl. Mater., 21: 355(Mar. 1967).

The Kraut–Kennedy melting relationship (E. A. Kraut and G. C. Kennedy, Phys. Rev. Lett. 16(1966)608) was applied to alpha to beta transformations in plutonium and uranium. Transformation temperature formulas were devised, although more data on other systems are needed for verification of the Kraut–Kennedy relationship. (J.G.B.)

24796 TRANSMISSION ELECTRON MICROSCOPY OF Pu-1 WT. PERCENT Ga. Brewer, A. W.; Fraikor, F. J. (Dow Chemical Co., Golden, Colo.). J. Nucl. Mater., 21: 345-8(Mar. 1967).

In order to better correlate microstructure, particularly dislocation configuration and interaction, with the bulk properties of plutonium and plutonium alloys, an attempt was made to observe directly dislocations in plutonium. Electron microscopic examination of Pu-1 wt % Ga foils revealed distinct dislocation images, some of which were due to a high degree of beam heating of the foils. (J.G.B.)

24797 KINETICS OF PRIMARY, CUMULATIVE, AND SECONDARY RECRYSTALLIZATION IN MOLYBDENUM FOIL. Belyakova, M. N.; Borimskaya, S. T.; Zasimchuk, E. E.; Larikov, L. N. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved., 23: 101-5(Jan. 1967). (In Russian).

Mo foil containing ~0.5% Ti was subjected to 80% deformation by rolling. The pole figure of the foil in deformed state was subjected to x-ray diffraction analysis, with hard radiation being recorded by means of a SRS type scintillation counter The structure of the foil was also examined. The texture of the deformed foil is chiefly described by the orientation (100) [011] as well as (112) [110] with rotation through 4 to 6° with respect to the direction of rolling about the axis perpendicular to the rolling plane. The temperature dependence of the growth rate of nuclei of primary recrystallization was investigated at 1050 to 1150°C. Subsequent annealing of the recrystallized foil at >2000°C led to its cumulative recrystallization—gradual enlargement of grains. The texture of primary recrystallization is described by the same orientations as the texture of deformation and is obtained from the texture of deformation by rotation through 12 to 15° relative to the direction of rolling about the axis perpendicular to the plane of the foil. The kinetics of the formation and growth of anomalous grains in the foil greatly resembles the kinetics of formation and growth of nuclei of primary recrystallization in polycrystalline material. The texture of secondary recrystallization is described by the orientation (100) [001] or (110) [001] depending on the annealing atmosphere. The shape of the anomalous grains arising on annealing of molybdenum foil is evidently associated with the original metallographic texture of the deformed foil and with the characteristic distribution of impurities along the boundaries of the extended grains, such that grain growth in the direction perpendicular to the direction of rolling is impeded. In thicker specimens which had not been subjected to prior deformation by rolling the shape of anomalous grains was equiaxial. (ATD)

24798 INVESTIGATION OF THE MARTENSITIC TRANSFORMATION IN N18K8M3T ALLOY. Gulyaev, A. P.; Karchevskaya, N. I. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved., 23: 184-7(Jan. 1967). (In Russian).

Specimens of N18K8M3T alloy (0.03% C, 18.26% Ni, 3.53% Mo, 0.34% Ti, 0.14% Al, 8.52% Co, 0.05% Si) were cooled at a constant rate from 950 to 220°C (the M_s temperature) and at a rate varying from 3 to 60 deg/min in the 220 to 100°C range (100°C is the M_f temperature). A change in the cooling rate in this range had no effect on the position of the martensitic range or on the transformation kinetics. At a low rate of cooling (9 deg/min) in the 950 to 220°C range, the initial stages of the transformation developed sluggishly and with a significant lag. For example, rapid cooling to 180°C resulted in 60% martensite, while low cooling resulted in only 30%, although the M_s point did not change. The effect of the cooling rate is probably associated with a more rapid accumulation of stresses with rapid cooling which account for the transformation development. Additional experiments on specimens 3.0 and 0.13 mm thick showed that thinner specimens require deeper supercooling to accumulate the stresses which initiate martensitic transformation. With isothermal transformation, the maximum amount of martensite was formed in the middle of the transformation range and the amount of martensite formed did not depend on the duration of isothermal holding. The reverse $\alpha \rightarrow \gamma$ transformation in the investigated alloy occurs in the 550 to 750°C range. However, the specimens which underwent complete $\alpha \rightarrow \gamma$ transformation required heating to 900°C to recover fully the capacity of austenite for martensitic transformation, although the M_s point remained the same (200°C). This indicated the diffusionless nature of the reverse $\alpha \rightarrow \gamma$ transformation which led to the formation of a strain-hardened γ-phase incapable of plastic deformation with the formation of martensite. It appears that higher heating temperature causes recrystallization processes in the strain-hardened austenite and gradually restores its capacity for martensitic transformation. (ATD)

24799 GROWTH TEXTURES IN BERYLLIUM CONDENSATES. Palatnik, L. S.; Fedorenko, A. I. (Polytechnical Inst., Kharkov). Fiz. Metal. Metalloved., 22: 637-9(Oct, 1966). (In Russian).

The structure of Be layers 30 to 50 mm thick and condensed on hot substrates was studied. The techniques for condensing and studying these films were developed. Transverse cross sections were etched in a weak (<1%) aqueous solution of oxalic acid. The development of growth texture in the columnar crystals proceeded to a definite thickness h_c, after which crystals of a single orientation remained on the surface layers, growing with a constant velocity. Microstructures showed that for $h > h_c$ the crystal dimensions in the surface layer do not change, since they experience the same growth conditions as the neighboring grains. The scattering angle of the maximum growth direction of the separate crystals to

the texture axis was less than 10° for $h > h_c$. With rise in substrate temperature (T_p), h_c increased because of decreased nuclei size: at T_p = 190°C, h_c = 30 μ; at T_p = 250°C, h_c > 80 μ. For T_p = 260 to 330°C micrographs of the surface showed two types of crystals, one of the [100] and the other of the [001] texture. The angle between the normal to the layer and the [001] and [100] direction (β) was given as a function of T_p for different orientations (ϕ) of crystallite clusters. Above 360°C, β increased sharply (to ±60° or more) for both [100] and [001] textures. Misorientation of texture depended on ϕ. The greatest degree of texture misorientation (β-(-β) = 120°) occurred at ϕ = 0, due to the equalized addition of vapor atoms to the growing velocities to dominate the growth of neighboring grains. However, at $\phi > 40°$ the perfection of the growth texture decreased. The optimum growth conditions for obtaining ideal [001] and [100] textures in Be layers were as follows: ϕ = 15 to −30°, T_p = 210° for [001] and T_p = 340 to 370°C for [100]. (ATD)

24800 PROCEEDINGS OF AN INTERNATIONAL CONFERENCE ON THE DEFORMATION OF CRYSTALLINE SOLIDS, OTTAWA, AUGUST 22–26, 1966. Can. J. Phys., 45: 453-863 (Feb. 1967). (CONF-660830-(No.2,Pt.2)).

Twenty-four papers are included from the conference with a separate abstract prepared for one paper. The remaining papers concern deformation in metals, alloys, and inorganic compounds. X-ray and electron-microscope techniques for studying deformation are described. (P.C.S.)

For an abstract of the individual paper see: 24801.

24801 DEFORMATION OF NIOBIUM SINGLE CRYSTALS. Foxall, R. A.; Duesbery, M. S.; Hirsch, P. B. (Cambridge Univ., Eng.). Can. J. Phys., 45: 607-29(Feb. 1967).

Various orientations of single crystals of Nb, purified by ultrahigh vacuum annealing, were tested in compression at 295°K and in tension at temperatures between 77 and 295°K. The shear stress–shear strain curves showed three-stage hardening in a manner similar to fcc crystals. Analysis of the orientation dependence of the operative slip system suggests an asymmetry in the critical resolved shear stress for slip on {112} planes, which increases with decreasing temperature. Explanations in terms of the various ways in which a ⟨111⟩ type screw dislocation can dissociate are proposed. It was found that dissociation on two {112} planes or composite dissociation on {110} and {112} planes leads to a satisfactory qualitative explanation of the experimental results. The dislocation distribution occurring as a function of strain was studied for crystals of a single-glide orientation deformed in tension at 295°K. (011) sections from crystals deformed into stage I contain clusters of primary edge dipoles. The density of secondary dislocations is low (~10%). Sections from crystals deformed into stage II were chosen such that the three-dimensional nature of the dislocation arrays could be investigated. The distribution shows strong similarities to those observed in copper crystals (Steeds 1966), i.e., edge multipole walls, tilt and twist boundaries. The density of secondary dislocations is high, being of the same order as the primary density. (auth)

24802 PROCEEDINGS OF AN INTERNATIONAL CONFERENCE ON THE DEFORMATION OF CRYSTALLINE SOLIDS, OTTAWA, AUGUST 22–26, 1966. Can. J. Phys., 45: 865-1249 (Feb. 1967). (CONF-660830-(No.2,Pt.3)).

Separate abstracts were prepared for 7 of the 28 papers included in this volume. The remaining papers discuss deformation characteristics of metals and alloys. (P.C.S.)

For abstracts of individual papers see: 24766–24772.

24803 MODERN TECHNIQUES IN METALLOGRAPHY. Brandon, D. G. Princeton, N. J., D. Van Nostrand Co., Inc., 1966. 273p. $13.50.

Subjects discussed are: classical optical metallography; the enhancement of contrast in the optical microscope; quantitative surface topography; the improvement of resolution in optical microscopy; electron microscopy of surfaces; transmission of radiation through matter; x-ray absorption microscopy; x-ray diffraction microscopy; absorption analysis, fluorescence analysis; electron-probe microanalysis; secondary ion emission analysis; field emission microscopy; field-ion microscopy; metallographic techniques; statistics of image observation and recording; quantitative analysis of microstructure; and automatic analysis. (J.G.B.)

Radiation Effects

Refer also to abstracts 24279 and 25190.

24804 (BNWL-SA-492) EFFECTS OF MINOR CONSTITUENTS ON THE IRRADIATION DAMAGE TO AUSTENITIC STAINLESS STEELS. Bement, A. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 12, 1966. Contract AT(45-1)-1830. 62p. (CONF-660627-15). Dep. CFSTI.

From American Society for Testing and Materials, 69th Annual Meeting, Atlantic City.

The effects of residual elements on the service behavior of austenitic stainless steels in present reactor systems are reviewed with respect to alloy stability in the temperature ranges for current and advanced reactor concepts. The stringent demands on these alloys in advanced reactor systems, which require long service life of stressed components under combined neutron flux, high temperature, and reactive coolant environments, are outlined. Changes in phase stability and precipitation reactions caused by atomic displacements at relatively low temperatures are discussed from the background of current neutron damage theory. High temperature nonrecoverable embrittlement of these alloys is described in terms of both carbide precipitation and helium generation mechanisms. Thermal-mechanical treatments have been found to be successful in reducing the magnitude of this embrittlement. In the case of fast breeder reactors, neutron reactions will cause a significant change in some alloy constituents and will cause the generation of helium and hydrogen gaseous products. Theoretical studies which have considered both the types of structural damage resulting from these neutron effects in different neutron spectra and the resulting effects of this damage on metallurgical behavior are discussed. (57 references). (auth)

24805 (EUR-3156.e) THERMOCOUPLE COMPOSITION CHANGES DUE TO NEUTRON IRRADIATION. Ehringer, H.; Mongini-Tamagnini, C.; Ponti, C. (European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center. European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1966. 42p. Dep.

Methods used to calculate thermocouple composition changes due to neutron irradiation in thermal reactors are described. For each of the considered elements (Pt, Rh, Mo, Fe, Ru, Pd, Ni) a reaction chain has been constructed, and the corresponding set of differential equations has been solved by means of a FORTRAN program on an IBM-7090 computer. Some interesting results concerning the reliability of the considered thermocouples are discussed. (auth)

24806 MEASUREMENT OF STORED ENERGY IN α-IRRADIATED ALUMINUM WITH A DIFFERENTIAL HEAT FLUX CALORIMETER. Boening, K.; Rief, E.; Wenzl, H.; Wipf, H. (Technische Hochschule, Munich). Z. Angew. Phys., 22: 529-37(1967). (In German).

A microcalorimeter is described for the measurement of the rate of heat release in thin foils and the specific heat of foils. Pure Al foils were irradiated with 3.6 MeV α-particles at liquid H_2 temperatures in this calorimeter. After irradiation the rate of energy release was measured during a linear rise of temperature with time. The stored energy ΔE is liberated in three stages, each showing fine structure: stage I (20 to 60°K), stage II (60 to 150°K), stage III (150 to 250°K). A comparison with similar annealing curves of electrical resistivity $\Delta\rho$ allows the determination of the ratios $\Delta E/\Delta\rho$ for the annealing stages. The values agree with corresponding values after neutron irradiation. (auth)

24807 RECOVERY OF ELECTRIC RESISTIVITY OF PURE METALS AFTER NEUTRON IRRADIATION WITH LOW DOSES AT 4.6°K IN A REACTOR. Burger, G.; Isebeck, K.; Voelkl, J.; Schilling, W.; Wenzl, H. (Technische Hochschule, Munich). Z. Angew. Phys., 22: 452-60(1967). (In German).

The recovery of the radiation-induced electrical resistivity was measured in the temperature region between 4.6 and 400°K in Al, Cu, Ag, and Au after short-time irradiation at 4.6°K inside the reactor core (integrated flux 3.6×10^{16} n/cm²). The results reflect the recombination and rearrangement of point defects in homogeneously distributed isolated defect cascades. By comparison with recovery measurements after electron irradiation it is possible to explain the main features of the annealing spectra, taking into account the high energy transfer during defect production and the specific defect arrangement within the cascades. (auth)

24808 RADIATION EFFECTS, DIFFUSION AND BODY-CENTERED CUBIC METALS. Wechsler, M. S. (Oak Ridge National Lab., Tenn.). pp 291-315 of Diffusion in Body-Centered Cubic Metals. Metals Park, Ohio, American Society for Metals, 1965.

The effects of radiation on bcc metals is reviewed with 73 references cited. The aspects of radiation effects bearing on diffusion and diffusion-controlled phenomena are emphasized. An expression was derived for determination of the displacement production rate (K). Experiments are described for determination of K by measurement of electrical resistivity. The annealing of radiation damage, channeling and focusing in metallic crystals, and radiation-enhanced diffusion are discussed. (B.L.M.)

24809 EFFECT OF NEUTRON IRRADIATION ON PRECIPITATION OF CARBON IN ALPHA IRON. Damask, A. C.

(Brookhaven National Lab., Upton, N. Y. Frankford Arsenal, Philadelphia). pp 317-28 of Diffusion in Body-Centered Cubic Metals. Metals Park, Ohio, American Society for Metals, 1965.

Neutron irradiation of solution of C in α-Fe in which the solute was in interstitial positions was observed to produce two effects: severe local damage creating sites for heterogeneous nucleation of the precipitates and the lattice vacancies serving as traps for the diffusing interstitial solute atoms to retard precipitation of the solute. These effects were studied with the following experimental techniques: internal friction, electrical resistivity, electron microscopy, and calorimetry. The sequence of defect migrations following the low-temperature irradiation and their effect on the precipitation of C are discussed in detail. (B,L,M.)

24810 EFFECT OF IRRADIATION ON PRECIPITATION OF NITRIDES IN IRON. Stanley, J. T. (Oak Ridge National Lab., Tenn.). pp 349-56 of Diffusion in Body-Centered Cubic Metals. Metals Park, Ohio, American Society for Metals, 1965.

Experiments on the effect of irradiation on precipitates of nitrides in Fe were carried out at doses such that the number of point defects produced by the irradiation was much smaller than the number of N atoms. Neutron irradiation of supersaturated Fe–N solutions caused enhancement in the rate of precipitation caused by nucleation cites due to the irradiation. A lack of enhancement rate of precipitation after electron irradiation is taken as an indication that individual lattice defects cannot produce the nucleation sites for precipitation. (B,L,M.)

24811 THE EFFECT OF IRRADIATION ON THE HIGH TEMPERATURE FRACTURE OF STAINLESS STEEL. Waddington, J. S.; Lofthouse, K. (Berkeley Nuclear Labs., Eng.). J. Nucl. Mater., 22: 205-13(May 1967).

The dependence of the high-temperature ductility of 20 wt % Cr–25 wt % Ni stainless steel on test conditions and grain size was related to the mode of intergranular fracture. Under some test conditions, thermal neutron irradiation was found to reduce ductility and the results suggest that this may be caused by an increased rate of crack propagation. (auth)

24812 STRESS RELAXATION IN NEUTRON IRRADIATED COPPER SINGLE CRYSTALS. Koppenaal, T. J. (Argonne National Lab., Ill.). Acta Met., 15: 681-90(May 1967).

The thermally activated slip mechanism in neutron irradiated Cu single crystals was investigated with stress relaxation measurements from 77 to 420°K. The stress dependence of the strain rate at constant temperature and the temperature dependence of the flow stress at constant strain rate were established. Using these two quantities, the activation enthalpy and activation parameters are in good agreement with the theoretical stress dependencies predicted by the Fleischer theory for strengthening by tetragonal distortions. An experimental force–distance curve for the dislocation–defect interaction responsible for neutron irradiation strengthening is also in excellent agreement with Fleischer's theory. The results indicate that the thermally activated, rate controlling mechanism for slip in these crystals can be expressed entirely through the relationship, $\dot{\gamma} = \dot{\gamma}_0 \exp -H_0/kT\,[1 - (\tau^*/\tau_0^*)^{1/2}]^2$, where $\dot{\gamma}$ is the strain rate, $\dot{\gamma}_0$ a constant, H_0 (= 3.0 eV) the activation enthalpy at zero effective stress, τ^* the effective stress, τ_0^* the effective stress at 0°K, and kT has the usual meaning. (auth)

24813 THE DISTRIBUTION OF AND SWELLING PRODUCED BY FISSION GAS BUBBLES IN α AND β URANIUM IRRADIATED UNDER LOW STRESS. Hudson, B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 22: 121-36(May 1967). (AERE-R-5039).

Specimens of U, 50 μm thick and of various compositions, were irradiated at ~400, ~500, 620, and 715°C under conditions where induced stresses should be small, and the distribution of porosity was studied using the electron microscope transmission technique after irradiation. Results show that the pre-existing precipitates have not affected the scale of bubble distribution, and that swelling due to bubbles within the grains is small. It was concluded, therefore, that under stress-free conditions at burnups of less than 0.2% there is no large swelling due to evenly distributed gas bubbles within the grains. (auth)

24814 EMBRITTLEMENT OF NEUTRON-IRRADIATED 20Cr–25Ni–Nb AUSTENITIC STEEL AT 650°C. Roy, R. B.; Solly, B. (Aktiebolaget Atomenergi, Studsvik, Sweden). J. Iron Steel Inst. (London), 205: 58-61(Jan. 1967).

The embrittlement of neutron-irradiated tensile specimens of 20Cr–25Ni–Nb steel at 650°C was studied by electron microscopy. The tensile elongation of irradiated specimens was reduced by 50%, the reduction being mainly in the uniform part of the elongation. Yield stress was considerably increased due to irradiation, while ultimate tensile strength was slightly decreased. The bubble model was not adequate to explain the observed embrittlement at the test temperature used. Experimental evidence for the presence of He bubbles was also lacking. In agreement with other results, irradiation-modified precipitation of the inter- and intragranular carbide phases was confirmed. The intragranular precipitates were identified as NbC while grain boundaries contained both NbC and M_6C precipitates. Grain boundaries of the irradiated specimens appeared to contain more precipitates than the unirradiated ones. It is suggested that the irradiation-induced embrittlement observed in 20Cr–25Ni–Nb austenitic steels at 650°C is probably due to the initiation of wedge cracks. (BBB)

24815 NEUTRON-DIFFRACTION INVESTIGATION OF RADIATION-INDUCED ORDERING IN Ni_3Mn AND Ni_4FeMn ALLOYS. Gneushev, V. N.; Lyashchenko, B. G.; Matovarov, V. A.; Novak, L. I.; Sarksyan, V. V. Dokl. Akad. Nauk SSSR, 171: 81-3(Nov. 1, 1966). (In Russian).

Tests were made on polycrystalline samples irradiated in a type SM reactor in an integral fast-neutron flux 3.5×10^{17} n/cm^2 at a temperature 60 to 70°C. Neutron diffraction pictures were taken 56, 74, and 87 or more days following the irradiation. Both samples exhibited ordering action of the reactor irradiation, with (001) and (011) lines appearing for the Ni–Fe–Mn compound, and also smeared (012) and (112) lines for the Ni–Mn alloy. The latter two lines indicate that long-range atomic order is also produced. The degrees of long-range order, determined from the ratios of the intensities of the superstructure lines (001) and (011) to the intensity of the main line (111), differed by almost a factor or two. This difference is attributed to the anisotropy of the distribution of radiation defects. It was concluded from the results that ordering of a previously disordered Ni_3Mn alloy is feasible, and that this phenomenon depends on the conditions under which the experiments were made. Orig. art. has: 1 figure and 1 table. (ATD)

24816 VACANCY MECHANSIM OF THE ACCELERATED FAILURE OF MATERIALS AT IRRADIATION UNDER STRESS. Karasev, V. S. Dokl. Akad. Nauk SSSR, 171: 84-7(Nov. 1, 1966). (In Russian).

A theoretical study is presented of the effect of irradiation with fast neutrons on the processes of deformation and failure of metals. Equations were derived, which show that coagulation of vacancies into complexes plays a significant part in the process of deformation and failure. Stress-rupture tests with a Cr–Ni heat-resistant steel (20% Cr, 28% Ni) showed that irradiation increased the creep rate and accelerated steel failure. The specimens strained to rupture in the reactor failed in a brittle manner without necking and with numerous cracks along the grain boundaries. The relative decrease in the rupture life of steel subjected to stress-rupture tests and irradiation at various temperatures under a constant load: $\xi = \tau_0/\tau_r$, where τ_0 is the rupture life of original steel and τ_r is the rupture life of irradiated steel, is shown. The determination of mechanical characteristics of materials after, instead of during irradiation, may lead to significant errors in estimating the service life of nuclear reactor parts located in fields of intense neutron radiation at temperatures higher than 0.4 of the melting temperature. (ATD)

24817 EMBRITTLEMENT OF OXIDE FILMS ON ZIRCONIUM BY NEUTRON IRRADIATION. Harrop, P. J.; Wanklyn, J. N. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 21: 310-16(Mar. 1967). (AERE-R-5294).

Anodic films on zirconium were irradiated in a nuclear reactor. Cracking between hardness indentations was not reproducible enough to offer a method for detecting embrittlement, but bending tests demonstrated embrittlement between 5×10^{19} and 3×10^{20} nvt (>1 MeV). Transmission electron microscopy of irradiated stripped film revealed no change in the mode of fracture on a fine scale. It is suggested that embrittlement may be the cause of the enhanced corrosion of zirconium alloys in power reactors. (auth)

24818 THE EFFECT OF NEON BOMBARDMENT ON THE CORROSION OF Zr. Harrop, P. J.; Wilkins, N. J. M.; Wanklyn, J. N. (Atomic Energy Research Establishment, Harwell, Eng.). Corros. Sci., 7: 289-97(May 1967). (AERE-R-5279).

Bombardment with 65-keV neon ions was used to simulate the effects of high neutron doses on oxidized Zr. The electric conductivity of anodic oxide films was enhanced for doses above 10 μA-min on a few square millimetres, but ultraviolet absorption was not detectably altered for doses up to 100 μA-min. Doses above μA-min sputtered away the surface of the oxide film with anisotropic sputtering ratio of 0.1. Thinly oxidized specimens that had suffered doses of 1 μA-min and above, when exposed to steam at 250°C at 1 atm, corroded at a considerably enhanced rate. This effect appeared to be independent of dose rate and to be an increasing function of dose. A thick anodic film showed no effect after 20 μA-min, suggesting that damage to the metal was important. Bare Zr and Zircaloy 2 specimens were irradiated to doses high enough to remove the air-formed film by sputtering. These also showed enhanced subsequent corrosion. (auth)

Ceramics and Cermets

Refer also to abstracts 24707 and 24710–24712.

24819 (ALO–3633–4) DEVELOP 1800F–400F FIBROUS-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS. Quarterly Progress Report No. 4, January 2–March 31, 1967. Collins, J. O. (Johns-Manville Research and Engineering Center, Manville, N. J.). Apr. 3, 1967. Contract AT(30-1)-3633. 120p. Dep. CFSTI.

Long term testing of Formulations 1999 and 2002 for PbTe RTG applications was completed for several of the physical properties. These included chemical compatibility with PbTe elements (final results still under analysis), load relaxation, and thermal stability. Outgassing and thermal conductivity tests were initiated during this quarter, but have not been completed. Other physical properties such as dynamic response, moisture adsorption/desorption, and shear have been completed. Chemical compatibility in air between SiGe elements and the fibrous candidates has completed the 2000 hr evaluation level. The same test in vacuum is approaching the 1500 hr level. Tests have also been initiated to evaluate the effect of prolonged contact between Irish Refrasil and SiGe bars as determined by Seebeck voltage and resistivity measurements. The effort to improve the temperature resistance of the MIN-K formulations has been concluded with the choice of Formulation 2020. Long term tests on this material were initiated. (auth)

Corrosion and Erosion

Refer also to abstract 25736.

24820 THE FREE ENERGIES OF FORMATION OF $\overline{CrS}$, $\overline{Mo_2S_3}$, AND $\overline{WS_2}$. Hager, John P.; Elliott, John F. (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME, 239: 513-20(Apr. 1967).

The standard free energies of formation of the lowest stable sulfides of Cr, Mo, Cu, and W in equilibrium with the corresponding metal were determined by reacting the sulfide and metal with $H_2(g)/H_2S(g)$ mixtures. The reaction is $x/yMe(c) + \frac{1}{2}S_2(g) = 1/yMe_xS_y(c)$. The results are $\Delta G_f^0(\overline{CrS}) = -48,400\ (\pm1100) + 13.4\ (\pm0.8)T$; ±300 cal [1375° to 1570°K] $\Delta G_f^0(\frac{1}{3}\overline{Mo_2S_3}) = -41,700\ (\pm1000) + 17.3\ (\pm0.6)T$; ± 300 cal [1365° to 1610°K] $\Delta G_f^0(\frac{1}{2}\overline{WS_2}) = -40,200\ (\pm1200) + 18.7\ (\pm0.9)T$; ±300 cal [1370° to 1565°K]. A method for estimating the standard molar entropies and standard entropies of formation at 298°K of the sulfides of refractory metals is presented. (auth)

24821 OXIDATION CHARACTERISTICS OF HAFNIUM AND ZIRCONIUM DIBORIDE. Kaufman, Larry (ManLabs, Inc., Cambridge, Mass.); Clougherty, Edward V.; Berkowitz-Mattuck, Joan B. Trans. Met. Soc. AIME, 239: 458-66(Apr. 1967).

Oxidation characteristics of HfB_2 and ZrB_2 were measured between 1200 and 2200°K by a thermal-conductivity method, which continuously measures the rate of reaction of O_2 with the diboride and by a metallographic air oxidation method, which provides a measure of the total amount of boride converted to oxide for a given time interval. The oxidized specimens obtained from the thermal-conductivity method were also examined by quantitative metallographic procedures. Metal-rich compositions of HfB_2 provided the most oxidation-resistant material up to 2000°K; HfB_2 was more oxidation-resistant than ZrB_2 at all temperatures; the morphology of the oxide formed on HfB_2 and the temperature coefficient of the oxidation rate constants changed at the temperature of the monoclinic to tetragonal phase transition in HfO_2; the oxidation of neither HfB_2 nor ZrB_2 resulted in catastrophic failure at low O_2 pressures; and preferential grain boundary oxidation was not observed for either. (auth)

24822 THE OXIDATION OF URANIUM-BASED CERAMICS. THE BEHAVIOUR OF UC AND OF UO_2 CONTAMINATED WITH CARBON CONTAINING PHASES. Menzies, I. A.; Strafford, K. N. (Univ. of Manchester, Eng.). J. Nucl. Mater., 21: 287-301(Mar. 1967).

The oxidation of UC granules was studied in dry CO_2 and in CO_2 containing ~2 vol % water vapor at 200 to 600°C. In dry CO_2 the initial rate of oxidation was rapid at all temperatures and an approximately linear relationship was observed. The product of oxidation of UC was UO_2. The presence of moisture in the CO_2, in general, accelerated the rate of oxidation of UC. At 200°C a linear relationship was observed whereas at 400 to 600°C the oxide film was more protective and an approximately parabolic relationship was obtained. The product of oxidation at 200°C was U_3O_8 and the formation of this oxide is attributed to oxygen impurities in the gas. The oxide formed at 600°C was, however, UO_2. High-density UO_2 containing major inclusions of $UC-UC_{1-x}O_x$ underwent rapid oxidative breakdown in dry CO_2 at 400 to 600°C due to preferential oxidation of the carbon-rich regions and disintegration of the compacts. It was found that oxidation of carbon/carbide-rich centers in UO_2 compacts prepared from UO_2 powder of high surface area (4–10 m^2/g) (without removal of the powder-binder before sintering) occurred preferentially at 800°C. This may also lead to disintegration of the compacts. (auth)

Preparation and Fabrication

Refer also to abstract 24739.

24823 (AAEC/E–162) LABORATORY DEVELOPMENT OF THE GRIND-LEACH PROCESS FOR THE H. T. G. C. R. FUEL CYCLE. PART III. COMMINUTION OF BERYLLIA MATRIX FUELS. Baillie, M. G.; Hubery, R. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct, 1966. 18p. Dep.

A comminution process has been studied for the preparation of fuel from an HTGCR pebble bed reactor for leaching prior to purification and recycle of its valuable constituents. The selection of suitable equipment for this step is discussed, and experimental work to demonstrate a three-stage vibratory grinding circuit on a small scale, using inactive fuel, is described. It has been shown that, for inactive fuel, a ground product having characteristics which make it suitable for feed material to the selective leaching step can be produced by this technique. (auth)

24824 (ORNL–4052) CHARACTERIZATION AND PRODUCTION OF U_3O_8 FOR THE HIGH FLUX ISOTOPE REACTOR. Werner, W. J.; Barkman, J. R. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-36. 36p. Dep. CFSTI.

The preparation and characterization of U_3O_8 used in the Oak Ridge National Laboratory HFIR fuel plates are described. The high performance required for the fuel plates demands uniformity of fuel distribution, and so nondestructive techniques were developed to detect and evaluate changes in fuel loading. Commercial oxide suffered severe comminution during plate fabrication and thereby biased plate homogeneity inspection. This factor plus the absence of irradiation data on this differing material under HFIR burnup made the use of such an oxide questionable. Morphology, microstructure, and behavior in plate fabrication are compared for a commercial oxide and an oxide manufactured at Y-12. The Y-12 oxide manufacturing process consists of peroxide precipitation from $UO_2(NO_3)_2$ solution, calcining, and sintering. The propensity toward comminution during fabrication showed by commercial U_3O_8 is reflected by a surface area greater than 0.05 m^2/g, as measured by a static BET krypton-adsorption method. Consistent with this, the commercial U_3O_8 particles exhibited a large number of microcracks when observed under the microscope, while the Y-12 oxide particles were rounded and contained few cracks. (auth)

24825 (ORNL–TM–1812) A FEASIBILITY STUDY: FORMATION OF URANIUM NITRIDE COMPOUNDS USING CHEMICAL-VAPOR DEPOSITION TECHNIQUES. Robinson, W. C. Jr.; Martin, W. R. (Oak Ridge National Lab., Tenn.). May 1967. Contract W-7405-eng-26. 10p. Dep. CFSTI.

The feasibility of the direct gas phase reduction of UF_6 to U metal according to the reaction: $UF_6(g) + 6Li(g) \rightarrow U(s) + 6LiF(g)$ was demonstrated. N_2 was then introduced into the chamber simultaneously with UF_6 and Li vapor to form a U–N compound. At temperatures and pressures selected, thermodynamic data indicate U nitrides to be stable. The reaction produced UN, UN_2, U, LiF, and other complex (U, Li, F) compounds. It was proved possible to form U nitrides by this technique; however, clean separation of the desired material and the reaction products was not feasible in the apparatus used. (auth)

24826 METHOD FOR PREPARING DENSE SPHERICAL PARTICLES OF THORIUM AND THORIUM–URANIUM DICARBIDES. Hamner, R. L.; Pilloton, R. L.; Kegley, T. M. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Appl., 3: 287-93(May 1967). (ORNL–P–2483).

A process, developed for preparing dense, spherical particles of ThC_2 and $(Th,U)C_2$, consists of heating dense sol-gel oxide microspheres with lampblack in a rotating crucible under a flow of argon at 1900 to 2200°C. A precise rotational speed and a special crucible design were necessary to maintain good oxide-to-carbon contact, and to prevent the particles from sintering together and bonding to the crucible wall. The products have a high degree of sphericity and surface smoothness, depending upon the starting sol-gel oxide microspheres. Advantages of this process over others are that no elaborate blending techniques of oxide and carbon are required; densification or spheroidization is not required after the reduction reaction; and the temperature of the process is lower than that of many spheroidization methods. (auth)

24827 SOLID-STATE STUDIES OF OXYGEN-DEFICIENT TANTALUM PENTOXIDE. Kudrak, Daniel R.; Sienko, M. J.

(Cornell Univ., Ithaca, N. Y.). Inorg. Chem., 6: 880-4(May 1967).

Although several lower oxides of Ta, Ta_4O, Ta_2O, TaO, TaO_2, TaO_x ($2 < x < 2.5$), were reported in the literature, only the last, TaO_x, could be reproduced. Single crystals of composition $Ta_2O_{4.73}$ were prepared by vacuum fusion of Ta_2O_5 in Ta, using radiofrequency induction heating at about 1900°C. Potential-probe conductivity studies disclosed metallic behavior, the resistivity rising almost linearly from 0.63×10^{-2} ohm cm at 4.2°K to 4.3×10^{-2} ohm cm at 295°K. Hall voltage measurements indicated n-type carriers at densities of 4.5×10^{20} cm^{-3}, independent of temperature. The Seebeck coefficient was found to change linearly from -10 μv deg^{-1} at 90°K to -50 μv deg^{-1} at 300°K. Magnetic susceptibility, measured by the Curie method, was small and negative. Observed properties were consistent with a d-type conduction-band model in which donor centers are so concentrated that degenerate electron gas behavior results. Density data on single crystals suggest that the oxygen defect actually arises from Ta interstitials. The thermal dependence of carrier mobility were quantitatively consistent with optical mode lattice scattering. (auth)

24828 FLOATING ZONE CRYSTAL GROWTH OF LANTHANUM HEXABORIDE. Curtis, B. J. (RCA Labs., Zurich); Graffenberger, H. Mater. Res. Stand., 1: 27-31(Sept. 1966).

The starting material, LaB_6 powder, was dried at 250°C for 12 hr in air. The powder was then melted into rough bars under an Ar atmosphere in a water-cooled Cu boat by induction heating. The LaB_6 rod was mounted inside a silica tube in a cage consisting of 2 water-cooled brass tubes fitted into graphite end pieces that carried the steel sample holders and bearings. A molten zone was established, and the cage was lowered at a rate of 8 to 20 mm/hr to allow the passage of a molten zone from bottom to top. The resulting rods usually consisted of 3 or 4 grains per cross-section, and the maximum observed grain length was about 10 mm. A preferred growth direction was not found but the growth axis appeared to be restricted to a zone up to about 30° on either side of the [110] direction. LaB_6 in single crystal grains 4 to 10 mm long and 1 to 2 mm across was prepared by the floating-zone technique. (BBB)

24829 APPLYING CARBIDE COATINGS BY ADHESIVE BONDING. Fawcett, William E. (Kennametal Inc., Latrobe, Pa.). Metal Progr., 91: No. 5, 91-2(May 1967).

Adhesive-bonding studies showed that chemical- and heat-activated adhesives provide an acceptable bonding method for joining WC to inexpensive backings without danger of cracking or warping which occurs in brazed assemblies. Although bonds of epoxy resin adhesives are only $\frac{1}{10}$ as strong in shear and lose strength rapidly above 250°F, proper design can alleviate these deficiencies. Methodology and uses for the epoxy carbide are discussed. (P.C.S.)

Properties Evaluations

Refer also to abstracts 24749, 24827, 24859, and 25735.

24830 (AAEC/E-157) HIGH TEMPERATURE THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE. McDonald, D. L.; Dullow, R. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug. 1966. 12p. Dep.

The thermal conductivity of BeO samples produced by isopressing at 20 ton in^{-2} and sintering at 1505°C was measured at 360 to 1200°K. The BeO compacts measured had a density of 2.85 g cm^{-3} and an average grain size of 6μ. The thermal conductivity was found to be given by the relation $k = 1.01 \times 10^4\ T^{-1.47}$, where k is the thermal conductivity (watt (cm deg $K)^{-1}$) and T is the absolute temperature. This result is compared with other thermal conductivity measurements on similar materials. (auth)

24831 (CONF-651101-89) DETERMINATION OF THE MELTING POINT OF UO_{2+x} ($-0.25 \leq x \leq 0$). Latta, R. E.; Fryxell, R. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). [1965]. Contract AT(40-1)-2847. 11p. (GE-TM-65-11-8). Dep. CFSTI.

From 13th Conference on Remote Systems Technology, Washington, D. C.

Studies were undertaken to determine the melting point of UO_{2+x} for values of x in the range $-0.25 \leq x \leq 0.003$. The melting point was determined by detection of a thermal arrest during solidification of the sample. The average melting points determined for each set of samples were all within a range of 7°C. A least-squares calculation fitted to a second degree equation yielded: $T°C_{mp} = -9443 + 11488(O/U) - 2665(O/U)^2$ for the range $1.75 < O/U \leq 2.003$. Data are presented in tables and graphs. (M.C.G.)

24832 (GA-7827) ADVANCED GRAPHITE FUEL SYSTEMS. Quarterly Progress Report for the Period Ending February 14, 1967. Bokros, J. C.; Engle, G. B.; Price, R. J.; White, J. L. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Mar. 10, 1967. Contract AT(04-3)-167. 50p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Developments are reported for studies on: structure of carbonized coal-tar pitch; characterization of degree of graphitization of C and graphite; influence of pitch-binder content on the properties and irradiation behavior of molded graphite bodies; thermal expansion and preferred orientation of nongraphitic carbons; radiation-induced dimensional changes in model carbons and graphites; and annealing of pyrolytic carbon structures. (P.C.H.)

24833 (GEAP-5433) SODIUM COOLED REACTORS FAST CERAMIC REACTOR DEVELOPMENT PROGRAM. Quarterly Report No. 21, November 1966-January 1967. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Feb. 1967. Contract AT(04-3)-189. 89p. Dep. CFSTI.

The Fast Ceramic Reactor Development Program is an integrated analytical and experimental program directed toward the development of fast reactors employing ceramic fuels, with particular attention to mixed PuO_2-UO_2. Developments are reported for studies on: vented fuel development; transient testing of fuels; fuel performance evaluation; fast flux irradiation of fuel; reactor physics and core analysis; and FCR cladding evaluation. (P.C.H.)

24834 (NP-16700) SUPPLEMENTARY DIELECTRIC-CONSTANT AND LOSS MEASUREMENTS ON HIGH-TEMPERATURE MATERIALS. Technical Report 203. Iglesias, J.; Westphal, W. B. (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). Jan. 1967. Contracts Nonr-1841(10); AF33(615)-2199. 119p.

Data on dielectric constant and loss measurements made after 1958, excepting high-dielectric-constant materials, are tabulated. The emphasis is on high-temperature materials (those with melting points above 1200°C), but data on some plastics and liquids are also included. The samples of solids include oxides of Al, Be, Cr, Hf, Mg, Si, Ta, Th, Y, Zr, nitrides of B and Si, $LaAlO_3$ and various silicates, rocks, and minerals. Pure samples of Al_2O_3, BeO, MgO, SiO_2, and BN all show loss tangents <0.01 at 1500°C in the microwave region. Various phenomena of electric loss, e.g., transconductance, dipole orientation, and molecular vibrations are clearly discernible. (auth)

24835 VALENCY STATE OF PERIPHERAL CARBON ATOMS ON THE SURFACE OF A FRESH GRAPHITE FRACTURE. Kiselev, V. F.; Nikitina, O. V. (Moscow State Univ. Scientific-Research Inst. of the Tire Industry, Moscow). Dokl. Akad. Nauk SSSR, 171: 374-7(Nov. 11, 1966). (In Russian).

The adsorption properties and the electron paramagnetic resonance spectra of graphite powders vibropulverized under different conditions were studied. The specific surfaces of the specimens determined (after completion of adsorption measurements) from low-temperature adsorption of N_2 varied from 180 to 230 m^2/g, corresponding to particle size of about 200 Å. Plotting of μmoles/m^2 versus torrs of pressure gave a variable of irreversible adsorption of 0.65 μmole/m^2. Considering that O is adsorbed in the atomic form, this is equivalent to a concentration of active sites of about 10^{14} sites/cm^2. However, this value characterizes the mean concentration of sites over the entire particle surface. Only the prismatic facets are reactive. Recalculation of the concentration of active sites on the surface of the prismatic facets leads to a value of about 10^{15} sites/cm^2, which is close to the concentration of C atoms on the surface of these facets. (JPRS)

24836 DIFFUSION OF CARBON THROUGH ZIRCONIUM MONOCARBIDE. Sarian, S.; Criscione, J. M. (Union Carbide Corp., Parma, Ohio). J. Appl. Phys., 38: 1794-8(Mar. 15, 1967).

The diffusion coefficients of carbon in single and polycrystalline ZrC were measured in the temperature range 1350 to 2150°C, using radioactive tracer techniques. Volume and short-circuit enhanced tracer diffusion coefficients are represented by the expressions $D^* = 1.32 \times 10^3 \exp(-113\ 200/RT)$ cm^2/sec and $D^* = 1.6 \exp(-90\ 000/RT)$ cm^2/sec, respectively. The results are compared with apparent diffusion coefficients determined from existing carburization and high-temperature creep data. (auth)

24837 VACUUM THERMIONIC WORK FUNCTIONS AND THERMAL STABILITY OF TaB_2, ZrC, Mo_2C, $MoSi_2$, $TaSi_2$, AND WSi_2. Wilson, R. G.; McKee, W. E. (Hughes Research Labs., Malibu, Calif.). J. Appl. Phys., 38: 1716-18(Mar. 15, 1967).

Surfaces shown by x-ray diffraction measurements after fabrication to be TaB_2, ZrC, Mo_2C, $MoSi_2$, $TaSi_2$, and WSi_2 were subjected to vacuum thermionic work function and thermal stability measurements. Subsequent x-ray diffraction stoichiometry checks showed that only ZrC and Mo_2C remained stable after many hours at thermionic emission temperatures. TaB_2 decomposed to TaB + B when a diffusion barrier of TaC was provided under the TaB_2; the three disilicides decomposed to lower silicon content silicides. The vacuum work functions measured after outgassing were

TaB_2(4.32 eV), ZrC(3.70 eV), Mo_2C(4.74 eV), $MoSi_2$(4.73 eV), $TaSi_2$(4.71 eV), and WSi_2(4.62 eV), subject to some temperature dependencies, as described. (auth)

24838 THERMODYNAMIC PROPERTIES AND NONSTOICHIOMETRY OF THORIUM MONOCARBIDE. Satow, T. (Tohoku Univ., Sendai). J. Nucl. Mater., 21: 255-62 (Mar. 1967).

The values of emf in the cell W/Th, $ThF_4/CaF_2/ThF_4$, ThC_x/W were measured at the temperatures of 720 to 950°C and at the compositions of $0.13 \leq x \leq 1.60$. Thermodynamic informations of nonstoichiometric ThC were obtained. Lattice parameters and density of ThC were measured. Phase boundaries and lattice defects of this compound are discussed from the results. The anomaly at about 830°C of the sample of $ThC_{0.76}$ observed in the temperature dependences of emf is discussed on the basis of superlattice formation of carbon atoms and vacancies. (auth)

24839 THERMODYNAMIC PROPERTIES AND NONSTOICHIOMETRY OF THORIUM DICARBIDE. Satow, T. (Tohoku Univ., Sendai). J. Nucl. Mater., 21: 249-54(Mar. 1967).

A solid state electrochemical technique was used to obtain thermodynamic information on the thorium–carbon system with the composition of ThC_x in which the value of x ranges from 1.02 to 2.43. The electrochemical cells are the type W/Th, $ThF_4/CaF_2/ThF_4$, ThC_x/W. Measurements were made at 720 to 950°C. ThC_2 was found to be a nonstoichiometric compound with a considerable homogeneity range from the fact that the emf changed with the carbon content between x = 1.72 and x = 1.97. Partial molar free energies, entropies, and enthalpies of Th in the system were calculated. The partial molar free energies were negative and increased negatively with increasing temperature or with decreasing C content. The results of density measurement suggest that the lattice defect of this compound is the C vacancy. (auth)

24840 IGNITION OF URANIUM MONONITRIDE AND URANIUM MONOCARBIDE IN OXYGEN. Dell, R. M.; Wheeler, V. J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 21: 328-36(Mar. 1967).

An experimental study was made of the thermal ignition of UN and UC in oxygen and air. The products of reaction are U_3O_8 and N_2 or CO_2, respectively. Using sintered powders (UN) and small pieces of fabricated material (UN and UC) ignition temperatures in the range 280 to 400°C were measured. Twelve or more different factors were identified which influence either the reaction rate or the rate of heat removal and therefore help to define the ignition temperature. Of these, the surface area and particle size of the solid are the primary factors, with mass and geometry of the specimen and gas flow rate also playing important roles. (auth)

24841 ELECTRICAL RESISTIVITY, MAGNETIC SUSCEPTIBILITY, AND THERMAL EXPANSION OF THORIUM MONOCARBIDE. Satow, T. (Tohoku Univ., Sendai). J. Nucl. Mater., 21: 343-4(Mar. 1967).

The temperature dependence of the electrical resistivity of $ThC_{0.76}$ was measured and found to be substantially positive and nearly linear. The magnetic susceptibility of thorium monocarbides having compositions of $ThC_{0.76}$, $ThC_{0.82}$, $ThC_{0.92}$, and $ThC_{0.96}$ was measured over the range from room temperature to ≈930°C. Relatively weak paramagnetism was found to increase with decreasing carbon content. Thermal expansion measurements were made on $ThC_{0.76}$ and $ThC_{0.96}$. (J.G.B.)

24842 DIFFUSION OF NONVOLATILE FISSION PRODUCTS IN SUBSTOICHIOMETRIC UC. Schroerschwarz, R.; Lindner, R. (CCR-EURATOM, Ispra, Italy. Technical Univ., Brunswick). Radiochim. Acta, 6: 190-2(Dec. 1966).

The diffusion of some fission product isotopes (^{95}Zr, ^{95}Nb, ^{99}Mo, ^{99m}Tc, ^{147}Pm) in substoichiometric cast UC of ca. 4.5% C content was measured in the temperature range from 1300 to 1800°C. The diffusion activation energies range between 40 and 65 kcal/mole and diffusion coefficients of the order of 10^{-12} cm^2/sec are found at about 1500°C. Apart from these values referring mainly to volume diffusion the contribution of grain boundary transfer was tentatively investigated and activation energies are indicated 10 to 40% lower than those of the bulk diffusion. (auth)

24843 SLIDING ELECTRICAL CONTACT MATERIALS FOR USE IN ULTRAHIGH VACUUM. Clauss, Francis J. (Lockheed Palo Alto Research Labs., Palo Alto, Calif.); Kingery, Marshall K. J. Spacecraft Rockets, 4: 480-5(Apr. 1967).

Information on a new sliding contact material, 85 Ag-2.5 Cu-12.5 MoS_2 is presented. Experimental studies have demonstrated that it can operate in vacua to 10^{-9} torr at current densities up to at least 300 amp/in.^{2}, sliding velocities up to at least 425 in./min, and brush contact pressures from 6 to 10 psi. Brush wear is on the order of 20 mils/1000 hr of operation under such conditions, contact resistance is less than 0.5 mΩ/in.^{2}, and noise is less than 5 mv. Conventional brush materials under these conditions wear approximately 20 times as fast, cause severe ring wear, and create nearly 100 times as much electrical interference. The new material is stronger, easier to fabricate, and causes negligible ring wear; the noise level when operating at low current densities, as when transmitting data signals, is undetectable. (auth)

24844 USE OF MOLYBDENUM IN TiC-BASE CERMETS. New York, Climax Molybdenum Co., 1967. 60p.

The function of Mo addition in TiC-base cermets is discussed from the aspects of its physical, mechanical, and chemical functions, and the discussion is limited to those cermets in which Ni serves as a binder. The applications of the TiC-base cermets containing Mo in cutting tools, seals, and bearings are discussed at some length. Some other much less important uses are discussed very briefly. Other than the properties of major relevance to present uses of the cermets, a brief compilation of some other test data that have been reported on physical, mechanical, and corrosion characteristics is presented. (B.L.M.)

Structure and Phase Studies

Refer also to abstracts 24832 and 24833.

24845 (NYO–3716-1) THE INFLUENCE OF NON-STOICHIOMETRY ON THE STRUCTURE OF CARBIDES USING FIELD ION MICROSCOPY. Progress Report No. 1 up to February 28, 1967. Cinquina, L.; Meakin, J. D. (Franklin Inst. Research Labs., Philadelphia, Pa.). Contract AT(30-1)-3716. 21p. (P–C1870-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Studies with field ion microscopy definitely established that at least one carbide, α WC, can be successfully examined using He as imaging gas and that sufficiently well developed net planes are developed to permit an analysis of the atomic positions. The results are described. (P.C.H.)

24846 THEORY OF COLUMNAR GRAIN GROWTH AND CENTRAL VOID FORMATION IN OXIDE FUEL RODS. Nichols, F. A. (Bettis Atomic Power Lab., Pittsburgh). J. Nucl. Mater., 22: 214-22(May 1967). (WAPD-T-1933).

The motion of an initially spherical pore by a vapor transport mechanism when subjected to a thermal gradient was analyzed from first principles. A spherical pore was found to be unstable if capillarity effects are ignored. If the pore is small enough, surface tension is expected to maintain a nearly spherical shape. A larger pore (≥10 μm) is predicted to elongate along the thermal gradient (cigar-shape) and, if large enough, it will then break into a line of smaller spheroidal pores. The velocity of motion when the pressure in the pore is assumed to remain constant was found to be independent of radius; if the velocity is therefore insensitive to the actual shape of the pore, the equation can be employed to estimate the velocity of motion of the fabricated voids initially present in oxide fuel rods, and thus to provide time-temperature estimates for both columnar grain growth and central void formation. The theory is shown to be in satisfactory agreement with both in-pile and out-of-pile experiments. A limited discussion is also presented on the origin of lenticular voids and their relation to columnar grain growth. (auth)

24847 INVESTIGATION INTO THE PHASE COMPOSITION OF THE La_2O_3–WO_3 SYSTEM. Tyushevskaya, G. I.; Afonskii, N. S.; Spitsyn, Vikt. I. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 170: 859-60(Oct. 1, 1966). (In Russian).

The phase diagram of the La_2O_3–WO_3 system was investigated on the basis of mixtures of the two compounds by changing the composition in steps of 5 mole %; in the more complex composition range from 40 to 50 mole % WO_3, the composition was changed in 1 mole % steps. The mixtures were preheated at 800°C and then calcined at higher temperatures; this did not affect the phase structure or the x-ray diffraction pictures of the specimens. The phase diagram obtained indicated that in addition to the already known compounds $3La_2O_3 \cdot WO_3$ (I), $La_2O_3 \cdot WO_3$ (IV), and $La_2O_3 \cdot 3WO_3$ (V), the system includes also the compounds $3La_2O_3 \cdot 2WO_3$ (II) and $11La_2O_3 \cdot 9WO_3$ (III). Phase (I) possesses a fcc lattice with a = 11.6 Å, with the unordered structure of pyrochlore. X-ray diffraction pictures indicated that Phases (II), (III), and (IV) have a very complex structure. The compound $La_2O_3 \cdot WO_3$ undergoes a slow, irreversible transformation. The normal La wolframate, $La_2O_3 \cdot 3WO_3$ was found to possess the crystal structure described earlier. The complex nature of the system, with 4 compounds in the narrow, 25 to 50 mole % WO_3 range, rendered the x-ray diffraction study difficult. (TTT)

24848 CRYSTAL STRUCTURES OF UC_2. Bowman, Allen L.; Arnold, George P.; Witteman, Willard G.; Wallace, Terry C.; Nereson, Norris G. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Acta Crystallogr., 21: 670-1(Nov. 1966). (LA-DC-7759).

A high-temperature neutron diffraction study of UC_2 showed a

tetragonal phase at 1700°C with the C11a CaC_2 type structure, a_0 = 3.633, c_0 = 6.036 Å, z = 0.395, and a cubic phase at 1900°C with the B1 NaCl type structure, a_0 = 5.488 Å. The cubic phase contains C_2 groups whose alignment was reduced to two possible cases, free rotation or random orientation along [111]. (auth)

24849 THE MELTING-POINT DIAGRAM FOR THE SYSTEM URANIUM HEXAFLUORIDE–PLUTONIUM HEXAFLUORIDE. Trevorrow, L. E.; Steindler, M. J.; Steidl, D. V.; Savage, J. T. (Argonne National Lab., Ill.). Inorg. Chem., 6: 1060-1(May 1967).

A temperature–composition phase diagram was obtained from a thermal analysis of the UF_6–PuF_6 system. The shapes of the melting curves were characteristic of those exhibited by solid solutions, and the solidus and liquidus points were determined by intersections of linear portions of the curve. Liquidus points could not be determined accurately from cooling curves because of supercooling effects and the heat-transfer characteristics of the sample block assembly. All data accepted as measures of the solidus and liquidus points were obtained from the record of melting determinations. All mixtures melted at temperatures between the melting points of the pure compounds. There was no evidence for the formation of constant-melting mixtures. For the system UF_6–PuF_6, the observed liquidus points all lay in the vicinity of the ideal liquidus curve, however the observed solidus points all lay below the ideal solidus curves. Possible causes of the apparent bias of observed solidus points were discussed. Annealing was not considered for the system UF_6–PuF_6 because of the undesirable effects of extensive radiation decomposition of PuF_6, which would have occurred during the time sufficient for the solid-state annealing. (D.H.M.)

24850 THE SYSTEM UO_2–Eu_2O_3 AT HIGH TEMPERATURES. Grossman, L. N.; Lewis, J. E.; Rooney, D. M. (General Electric Co., Pleasanton, Calif.). J. Nucl. Mater., 21: 302-9(Mar. 1967).

Phase equilibria in the system Eu_2O_3–UO_2 were determined for high temperature and neutral atmosphere by thermal analysis, x-ray diffraction, and ceramography. Extensive solubility of Eu_2O_3 existed in the fluorite phase; no solubility of UO_2 in monoclinic Eu_2O_3 was found. Urania stabilized cubic Eu_2O_3 to about 1885°C. An eutectic was formed between the fluorite and monoclinic phases at approximately 80 mole % $EuO_{1.5}$; the eutectic temperature is 2125 ± 50°C. Lattice parameters, solidus temperatures, and liquidus temperatures are given for the fluorite phase. Subsolidus equilibria for the europia-rich region are postulated. Interaction between Eu_2O_3 and W was observed; a binary compound and binary invariant temperature are reported for the Eu_2O_3–W system. (auth)

24851 MULTILAYER VACANCY LOOPS IN GRAPHITE. Turnbull, J. A.; Stagg, M. S. (Central Electricity Generating Board, Berkeley, Eng.). Phil. Mag. (8), 15: 867-70(Apr. 1967).

After annealing thin foils of graphite single crystals in air at 10^{-3} torr and temperatures between 2100 and 2200°C, examination by electron microscopy revealed the presence of very large multilayer vacancy loops. Only a small number of these loops was sheared in any one multilayer defect; dislocation arrangements are proposed to illustrate how the high energy A over A stacking fault is avoided. A theory of successive nucleation has been used by Edington and West [Phil. Mag., 15: 229(1967)] to explain the nucleation of two- and three-layer defects in quenched Al. The same theory applied to this case showed that during the growth of a multilayer defect the nucleation conditions are independent of the number of loops, hence defects of upwards of ten loops are relatively common. (auth)

24852 INVESTIGATION OF THE STRUCTURE OF THIN FILMS OF LOW-TEMPERATURE PYROLYTIC GRAPHITE BY ELECTRON DIFFRACTION. Kurdyumov, A. V.; Pilyankevich, A. N.; Gnesin, G. G. (Inst. for the Problems of Materials Science, Kiev). Soviet Phys.-Cryst. (Engl. Transl.), 11: 739-42 (May-June 1967).

Translated from Kristallografiya, 11: 866-70(Nov.-Dec. 1966).

The three-dimensional order of the graphite structure, the average diameter of the graphite layers, and the magnitude of the microstresses within the crystal lattice of thin films of low-temperature pyrolytic graphite, obtained at temperatures of 700, 800, and 900°C, were studied by electron diffraction. The degree of three-dimensional order of the graphite structure was determined by the intensity distribution and the asymmetry of the hk lines. The average diameter of graphite layers L_{hk} and the magnitude of the microstresses $\Delta d/d$ were determined from the graph showing the dependence of the width of the lines on the reflection angle. The thickness of the films was of the order of 600 Å. (auth)

Radiation Effects

Refer also to abstracts 24832, 24833, and 25739.

24853 (EURAEC-1805) STUDY OF THE SHAPING AND IRRADIATION OF URANIUM CARBIDE. Quarterly Report No. 20, April 1–June 30, 1966. Devillard, J.; Morlot, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Contract 7589. 44p. (EUR-3346). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The device prepared for irradiation of 8% ^{235}U-enriched UC at 1000°C was altered; the specimens are surrounded with Nb wool to reduce NaK convection. The irradiation of a fuel pin with a core temperature of 750°C was scheduled in a Nb container. It was decided to discard the projected irradiations at 1500°C in the EL 3 reactor in favor of a CYRANO-type irradiation giving the same fuel core temperature and further permitting continuous measurement of the thermal parameters of the specimens. (auth)

24854 (N-67-14254) DEFECTS IN THE COMPOUND Bi_2Te_3 CAUSED BY IRRADIATION WITH PROTONS. Chaudhari, P.; Bever, Michael B. (Massachusetts Inst. of Tech., Cambridge). 1966. 18p. (NASA-CR-80847). CFSTI.

Single-crystal foils of Bi_2Te_3 were irradiated with 7.5-MeV protons at two levels of flux to the same integrated dose of 5.5×10^{18} protons/cm^2. The specimens were examined by transmission electron microscopy. After irradiation with a flux of 1.8×10^{13} protons/cm^2/sec, clusters of point defects ranging in size from approximately 50 to 250 au were observed. These clusters annealed out during examination in the electron microscope. After irradiation with a flux of 3.0×10^{13} protons/cm^2/sec, clusters of interstitial atoms and clusters of vacancies could be distinguished. Hexagonal areas were observed after irradiation with the higher flux. Irradiation also promoted the rearrangement of dislocations. Segments of dislocation intersected the surface of the specimens and dislocations acquired a jagged appearance. (auth)

24855 (SWRI-1228-55) TENSILE AND IMPACT PROPERTIES OF ELK RIVER REACTOR CONTROL ROD MATERIAL. Final Report. Wylie, Robert D. (Southwest Research Inst., San Antonio, Tex.). Feb. 19, 1965. Contract AT(11-1)-1228. 21p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Boron stainless steel specimens were removed from the Elk River Reactor during the shut down in early November 1964 and tested at Southwest Research Institute. Both subsize tensile and impact specimens were included in the surveillance program. An estimate of the flux level was made as 1.3×10^{20} NVT thermal as of August 31, 1964. This corresponds to approximately 0.22 at. % burnup. The ductility of the specimens was measured as 1 to 2% elongation, which was below the 3.4% required by the technical specifications. A literature review indicated that the measured ductility was in the range of the other test data available on boron stainless steels with approximately 2% boron. Tests made at reactor operating temperature revealed an increase in strength without a significant increase in ductility. (auth)

24856 PARTITION OF THE AVERAGE ENERGY DEPOSITED IN SILICON AS A FUNCTION OF INCIDENT NEUTRON ENERGY. Sattler, Allan R.; Vook, Frederick L. (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 155: 211-17(Mar. 10, 1967).

Calculations and experimental data of the partition of the average energy deposited in crystalline Si per incident neutron as a function of incident neutron energy are presented. The study is confined to the energy imparted from elastic and inelastic neutron scattering, and to that imparted from charged-particle production. As the incident neutron energy increases from 0.2 to 14 MeV, the average ionization energy deposited increases from $\approx 1 \times 10^{-9}$ to $\approx 1 \times 10^{-7}$ (erg/g) per (neutron/cm^2), and the energy available for displacements (nonionization) increases from $\approx 3 \times 10^{-9}$ to $\approx 6 \times 10^{-9}$ (erg/g) per (neutron/cm^2). The calculations of ionization are in good agreement with the experimental data. In addition, carrier-removal experiments in silicon performed with monoenergetic neutrons show agreement when normalized at 14 MeV with the calculations of the energy available for displacements. (auth)

24857 X-RAY EXAMINATION OF STRONTIUM TITANATE IRRADIATED BY FISSION FRAGMENTS. Rogers, M. D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 22: 223-5(May 1967).

$SiTiO_3$ was irradiated by fission fragments and examined by x-ray diffraction methods. The results were used to assess the behavior of $SrTiO_3$ undergoing self-irradiation by β particles when ^{90}Sr is used. (auth)

24858 ACCOMMODATION FACTORS: EFFECT ON THERMAL EXPANSION AND RADIATION-INDUCED DIMENSIONAL

CHANGES OF GRAPHITE. Morgan, W. C. (Battelle-Northwest, Richland, Wash.). J. Appl. Phys., 38: 1996-8(Mar. 15, 1967). (BNWL-SA-829).

In a recent paper, Price and Bokros (J. App. Phys., 36: 1897 (1965)) extended the work of Sutton and Howard (J. Nucl. Mater., 7: 58(1962)) in relating the coefficients of thermal expansion of polycrystalline graphite to the crystallite lattice expansion coefficients. In addition, Price and Bokros applied a similar analysis to dimensional changes induced by neutron radiation. It is recommended that the equations used by Price and Bokros be replaced with equations presented herein. The effects of the replacement on the data are shown. (W.D.M.)

24859 RESEARCH ACTIVITIES OF THE SOLID STATE PHYSICS LABORATORY OF THE JOINT RESEARCH CENTER, EURATOM, ISPRA. Camagni, P.; Manara, A.; Merlini, A. (CCR-EURATOM, Ispra, Italy). Neue Tech., 8: 350-9(Dec. 1966).

Research activities on physical properties and imperfections in crystalline solids are reviewed. The low-temperature facility for studies on damage by neutron irradiation is described. Effects of ionizing radiation in ionic solids are discussed. X-ray diffraction studies on lattice imperfections are reviewed. The thermal anelastic scattering of x rays was studied by means of the Moessbauer effect. Studies of point defects in metals and alloys by electric resistivity is reported. Sonic conductivity of alkali halides is discussed. Physical properties of UC are considered. (M.C.G.)

Plastics and Other Materials

Refer also to abstract 25696.

24860 ACCOMMODATION OF c-AXIS THERMAL EXPANSION IN POLYCRYSTALLINE GRAPHITE. Slagle, O. D. (Battelle-Northwest, Richland, Wash.). J. Appl. Phys., 38: 1993-4 (Mar. 15, 1967).

The coefficients of thermal expansion for polycrystalline graphite are considerably less than would be expected on the basis of single-crystal expansion coefficients. Previous calculations of the coefficients of thermal expansion on the basis of crystallite orientation have added empirical accommodation factors to account for discrepancies with experimental values. A method is proposed which takes into account this accommodation and gives satisfactory agreement with experimental values. (W.D.M.)

PHYSICS (GENERAL)

Astrophysics

Refer also to abstracts 24950, 24985, 24986, 25042, and 25466.

24861 (N-67-11353) NEUTRON CAPTURE REACTIONS AND STELLAR NUCLEOSYNTHESIS. Gibbons, John H. (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). Oct. 20, 1966. 30p. (NASA-TM-X-53527). CFSTI $3.00 cy, $0.65 mn.

The development of techniques for solving the problem of heavy element buildup is reviewed. Notable advances in the past leading up to the present technology are summarized, and modern methods are discussed and explained. The s-process hypothesis is presented and confirmed by accurate determination of the neutron capture cross sections and their correlation with isotopic abundance. The deduction of the r-process abundances, which involves neutron capture and beta decay by neutron-rich nuclides far from the valley of beta stability is presented, and the various lines of evidence for the r-process are outlined. Future projects in this field are also delineated. (STAR)

24862 (N-67-12168) THE DYNAMICAL STATE OF THE INTERSTELLAR GAS AND FIELD. II. TURBULENCE AND ENHANCED DIFFUSION. Parker, E. N. (Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies). Oct. 1966. 83p. (NASA-CR-80133; EFINS-66-96). CFSTI $3.00 cy, $0.65 mn.

The dynamical instability of the interstellar gas, caused by the galactic cosmic rays and magnetic field, is examined for the purpose of gaining a more detailed understanding of the phenomenon. The decrease of the field energy as the gas goes into clouds is illustrated with a simple example. It is shown, too, that a tissue of field, formed by superposing alternate layers of field at right angles to each other, fails to produce stability. As suggested earlier, it appears that there is no stable confinement of magnetic fields by the wright of the interstellar gas. It is shown that the instability develops very short wavelengths in the direction perpendicular to the galactic gravitational field and magnetic field. The result is that the interstellar gas must be in a continual state of turbulence and fragmentation, terminating only when the clouds become so dense that self-gravitation becomes dominant. The turbulence and fragmentation enhance ambipolar diffusion to such an extent that the field escapes from the gas rapidly compared to the usual ambipolar rates. It is suggested that this may contribute to the escape of the magnetic fields from the interstellar gas which forms stars. (auth)

24863 EXPERIMENTAL TEST OF THE FREUNDLICH REDSHIFT HYPOTHESIS. Blum, Gerald D.; Weiss, Rainer (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 155: 1412-13 (Mar. 25, 1967).

An experiment to test the Freundlich photon-scattering hypothesis, which was designed to explain the Hubble cosmological red shift, is described. Laser light is passed through an rf cavity placed in one arm of an interferometer sensitive to 10^{-8} fringe shift. The experiment sets a limit of $\Delta\nu/\nu < 10^{-18}$ on the frequency shift of 6328-Å photons passing through 2 m of X-band radiation field with an energy density of 2 erg/cm^3. (auth)

24864 POLARIZATION OF CELESTIAL X-RAYS. Dolan, Joseph F. (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Univ., Cambridge, Mass.). Space Sci. Rev., 6: 579-600(Mar. 1967).

The processes by which x radiation may be emitted by celestial sources are investigated, and the net polarization such radiation would possess is predicted. The amount of polarization observed at the earth would depend both on the mechanism producing the radiation and on the fractional extent of the source over which it is coherently polarized. Highly polarized x radiation would suggest synchrotron emission as the source mechanism. Radiation whose polarization is low but nonzero would be produced by synchrotron emission from a source whose magnetic fields are inhomogeneous on a large scale, or by bremsstrahlung of electrons whose velocity vectors lie in one predominant direction. Nonobservable polarization would result from sources of synchrotron radiation whose magnetic fields show small-scale irregularities, from the bremsstrahlung of electrons whose velocity vectors are either random or spherically symmetric in direction over the entire source, or from sources whose mechanism of producing the radiation imparts no net polarization, e.g., thermal radiation from neutron stars, line radiation from electronic shell transitions within atoms, and the inverse Compton effect. Measurement of the net polarization of the x rays from the several known celestial sources could thus lead to the specification of the mechanisms capable of producing the radiation from such sources. (auth)

24865 STATISTICAL INVESTIGATION OF GALACTIC SPIRAL STRUCTURE. Rohlfs, K. (CSIRO, Sydney). Z. Astrophys., 66: 225-33(1967).

Due to the nonuniform distribution of stars along the milky way the observed stellar distribution function has a star-like appearance centered on the sun which makes it difficult to recognize any spiral structure. Regions of enhanced stellar density can be detected by a comparison of this observed stellar distribution function with a synthetic one, which has the same marginal distributions, but no spiral structure. These positions coincide rather well with spiral arms as found by other means. Objective statistical tests show that OB aggregates, early-type clusters from O to B 2, H II regions, and early-type Be stars are reasonable spiral arm tracers. δ Cephei and Wolf-Rayet stars do not show spiral structure. (auth)

24866 BRIGHTNESS AND TEMPORAL VARIATION OF RADIO EMISSION FROM GALACTIC OH. Cook, A. H. (National Physical Lab., Teddington, Eng.). Nature, 214: 689-90(May 13, 1967).

It is stated that recent interferometric observations of the angular sizes of OH radio sources, which imply minimum brightness temperatures between 10^8 and 10^{11}°K, remove any theoretical difficulty in accepting the temporal variations of intensity that the radio astromony group at Berkeley claims to have detected. Arguments are presented to indicate that there is no reason to suppose that the Berkeley observations are improbable. It is difficult to understand why so few sources have been found to vary. (UK)

24867 MAXIMUM ROTATIONAL VELOCITIES. Brosche, P. (Astronomisches Rechen-Institut, Heidelberg). Z. Astrophys., 66: 161-9(1967). (In German).

The observed values for the maximum rotational velocities v_m — or their lower limits — are listed for 53 galaxies. From these data, mean values and dispersions are obtained for groups of galaxies according to their type (spiral or irregular), kind of observation (optical or 21 cm line), and completeness of observed rotation curve. The mean maximum rotational velocity is $\bar{v}_m = 220 \pm 63$ km/sec from optically observed maxima in 27 spirals. All groups of data indicate a value v_m systematically lower for the irregulars than for the spirals. This could even be understood by such evolutionary changes in the galactic structure which are compatible with conservation of mass and angular momentum. The released gravitational energy is capable of driving the turbulent motions of interstellar clouds. (auth)

24868 GLOBULAR CLUSTER NGC 362. Menzies, J. W. (Australian National Univ., Canberra). Nature, 214: 689(May 13, 1967).

This cluster is situated about 1° north of the north end of the Bar of the Small Magellanic Cloud. Details are given of its parameters, with particular regard to spectral type and colour. It appears to belong to the group of globular clusters typified by M3 and M5. The c-m diagram for the 332 stars in the cluster is depicted. It is stated that no galactic globular cluster is known having a c-m diagram similar to that of NGC 362. While NGC 362 shares many characteristics with the metal-deficient cluster M3, the horizontal branch in its c-m diagram is similar to those of 47 Tuc and NGC 6171, which are both only slightly deficient in metals. (UK)

24869 GRAVITATIONAL EFFECTS ON THE MOTION OF INTERSTELLAR GAS IN THE NEIGHBORHOOD OF A HOT RADIATING STAR. PART I. Goldsworthy, F. A. (Univ. of Leeds, Eng.). J. Inst. Math. Appl., 3: 60-75(Mar. 1967).

The way in which gravity influences the expansion of interstellar gas about a hot radiating star is discussed. The problem is of the singular perturbation variety, in which gravity plays a dominating role in the near vicinity of the star but small elsewhere, and the mathematical technique used is that of matching. The governing parameter is the ratio of the distance over which gravity effects are important to the radius of the ionized interstellar gas (HII) region, and only small values of this ratio are considered. The case when this is not so will be discussed in a later paper (Part II). (auth)

24870 FLUCTUATION CHARACTERISTIC AND RADIO-WAVE SPECTRUM IN INTERPLANETARY SPACE. Yakovlev, O. I.; Efimov, A. I. Radiotekh. Elektron., 11: 2064-6(Nov. 1966). (In Russian).

In considering the fluctuation characteristics and spectrum of radiowaves, the following approximations are adopted: (1) the ve-

locity of the solar wind v does not depend on the distance from the sun r; (2) the average electron concentration varies inversely as the square of the distance from the sun; (3) the degree of inhomogeneity of the plasma does not depend on r; (4) the spacial distribution of the fluctuations in electron concentration is isotropic. Expressions are derived for the average square of the amplitude fluctuations, the average square of the phase fluctuations, and the width of the energy spectrum of the radiowaves as a function of the angle ψ between the direction to the sun and the radiosource for various distances L from the source. A maximum in the width of the energy spectrum occurs at $\psi = 50°$. (TTT)

24871 COMPTON EFFECT ON RELATIVISTIC ELECTRONS IN THE SOLAR ATMOSPHERE. Korchak, A. A.; Ponomarenko, Yu. B. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 333-8(1966).

Translated from Geomagn. Aeronomiya, 6: 417-23(1966).

The Compton effect of thermal photons on relativistic electrons in the solar atmosphere is examined. The cross section and radiated power of hard photons are computed for two particular cases: for isotropic distribution of thermal photons and for their radial propagation. The form of the frequency spectrum of Compton photons for a monoenergetic and power-law spectrum of relativistic electrons is investigated. It is shown that for a power-law energy spectrum of electrons with an exponent κ, the radiation power increases with the increasing heligraphic longitude of a flare, θ, as $(\sin \theta/2)^{\kappa+1}$. (auth)

24872 COMET TAIL STREAMERS IN THE SOLAR WIND. Wallis, M. K. (Univ. of Manchester, Eng.). Planet. Space Sci., 15: 137-53(Jan. 1967).

Transverse plasma instabilities are suggested as the basis of the mechanism which couples the motions of the solar wind and cometary plasma. In a plasma with a nonisotropic distribution of particle velocities, collective interaction of the charged particles can lead to electromagnetic instabilities. In a shearing flow these plasma instabilities draw energy from that of the shear and ensure a short time of free flight for diffusing ions. A coefficient of viscosity for a mixed CO^+, H^+, and electron plasma based on this mechanism. Using in addition the related transport coefficients of thermal diffusion and conductivity the flow of a cometary streamer in the supersonic solar wind is derived. Viscous heating of the cometary plasma is shown to be important and is taken into account in the derivation of a similarity solution for the steady flow of a straight streamer. The length of a typical streamer is predicted to be about one hundred times its width, showing that the stability of comet rays against diffusion can be explained without invoking a magnetic field. The hydrodynamic stability and extreme straightness of the tail rays are due to the hypersonic nature of the flow. Finally, the variation with distance of the density, and velocity of ions in the tail rays is deduced, and is compared with observations. (auth)

24873 STRUCTURE OF THE SOLAR PLASMA FLOW GENERATED BY SOLAR FLARES. Akasofu, S.-I.; Yoshida, S. (Univ. of Alaska, College). Planet. Space Sci., 15: 39-47(Jan. 1967).

Characteristics of geomagnetic storms caused by solar flares at different central meridian distances are statistically examined to obtain a two-dimensional configuration of the solar plasma flow generated by solar flares. It is shown that the front of the plasma flow is nearly hemispherical, but its energy flux is greatly concentrated in a narrow cone from intense solar flares; therefore, the energy flux has a jet structure. It is shown that these results can be reasonably combined to give a consistent picture by assuming the generation of an interplanetary shock wave by the jet of the solar plasma ejected by a solar flare. (auth)

24874 ON THE INTERPRETATION OF STRONG He I LINES IN EARLY TYPE SPECTRA. Messerschmidt, Dietrich; Scholz, Michael T.; Traving, Gerhard (Hamburger Sternwarte, Hamburg). Z. Astrophys., 66: 246-51(1967).

The wings of some strong HeI lines (2P–nD) were computed using recent Stark effect calculations of H. Pfennig and E. Trefftz. Satisfactory agreement of theoretical and observed profiles was achieved. (auth)

24875 BEHAVIOR OF PHOTOSPHERIC GRANULATION IN SPOT CYCLES. Birkle, K. (Fraunhofer-Institut, Freiburg i. B.). Z. Astrophys., 66: 252-63(1967). (In German).

A possible relation between the number of photospheric granules and the Wolf sunspot number, as found by C. Macris and D. Elias, 1955, was retested. For this purpose, the density number of granules (number of granules per $10'' \times 10''$ area on the solar disk, reduced to the disk's center) within inactive regions of the photosphere was measured on a homogeneous sample of granulation photographs covering a period of 15 years. No change in the density number during the solar cycle could be found, the standard deviation of individual measurements being ±4%, which is essentially less than the variation in the number of granules as measured by the authors mentioned above. The measurements of apparent granule density number indicated a center-limb variation (decrease of density with increasing ϑ), already for the central part of the solar disk ($\vartheta < 30°$). A tentative explanation is given. From measurements of granule density on a Stratoscope-I photograph a mean distance between neighboring granules of 1.9″ was derived. (auth)

24876 AXIAL ROTATION OF LATE-TYPE DWARFS. Kumar, Shiv S. (Univ. of Virginia, Charlottesville). Z. Astrophys., 66: 264-7(1967).

It was first pointed out by Struve that late-type dwarfs on the main sequence rotate much more slowly than stars of earlier spectral types. To explain this drop in angular momentum of late-type dwarfs, Struve suggested that they are accompanied by solar systems similar to our own. It is proposed that instead of a solar system, a late-type dwarf may be accompanied by a low-mass black dwarf in an elliptical orbit and, consequently, the number of solar systems in the Galaxy may not be as large as given by Struve and other workers. (auth)

24877 PURE HELIUM MODEL STELLAR ATMOSPHERE. Hunger, Kurt (Technische Hochschule, Hanover); Van Blerkom, David. Z. Astrophys., 66: 185-99(1967).

A model atmosphere is calculated for a pure helium star with $T_{eff} = 18{,}000°K$ and $\log g = 3.5$ (c.g.s.), approximating the hydrogen deficient star BD + 10°2179. The only sources of opacity included are bound–free and free–free transitions of HeI and HeII and electron scattering. The effects of line blanketing and Rayleigh scattering are neglected. (auth)

24878 STATES OF PHOTOSPHERIC LAYERS OF SOLAR FACULAE. Schmahl, G. (Univ., Goettingen, Ger.). Z. Astrophys., 66: 81-117(1967). (In German).

Photoelectric measurements of the continuum intensity differences of faculae and undisturbed photosphere in the wavelength region λλ 3659 to 6540 A were made together with concave grating spectra in the region λλ 3800 to 8600 A. The measurements refer to a mixture of granules and intergranules. The investigation leads to the following results: (1) The measured intensity differences in the center of the solar disk are greater than zero even for weak faculae. Therefore it is not necessary to suppose a temperature deficit in deep layers of faculae. (2) From the continuum alone one cannot derive unequivocal temperature stratifications. (3) Only models of faculae with rather small temperature differences beginning at $\tau_0 \approx 1$ (τ_0 = optical depth at 5000 A) are in agreement with the measured equivalent widths of medium strong lines (models III/1, III/2). Models with temperature differences beginning at smaller optical depths (for instance $\tau_0 = 0.1$ or 0.01) are not in agreement with the measurements of the lines. (4) The models which are in agreement with the measurements have smaller gas pressures than the model of the undisturbed photosphere at the same geometrical depths. The differences can be compensated by magnetic fields with flux densities of several hundred gauss in agreement with the observation. (auth)

24879 IONIZATION STRUCTURE OF PLANETARY NEBULAE. Goodson, Wilfred L. (Lehrstuhl fuer Theoretische Astrophysik, Heidelberg). Z. Astrophysik, 66: 118-55(1967). (In German).

The ionization structure of the elements H, He, C, N, O, and Ne was computed for a sequence of planetary nebulae. A theoretical determination of the electron temperature was included in the problem. The variation of electron density was taken into account. The frequency dependence of the surface flux of the central stars $F_\nu(0)$ was taken from the model atmosphere computations of Böhm and Deinzer, 1965, 1966. Additionally, a method was developed for interpolating $F_\nu(0)$ for values of T_{eff} and g pairs lying between the models. The ionization equilibrium is given for seven models. The mean electron density and the distribution of each element on its different stages of ionization integrated over the entire nebular volume is given as a function of the central star temperature. (auth)

24880 FORBIDDEN NI LINES IN THE FRAUNHOFER SPECTRUM. Swensson, J. W. (Univ., Liege. Univ., Lund, Sweden). Z. Astrophys., 66: 156-60(1967).

Since 1952 there have been several attempts to identify the forbidden multiplet $^3D^0 - {}^3P^0$ of NI in the Fraunhofer spectrum. A renewed search for these lines, near λ 10400, was made with the aid of K. B. S. Eriksson's recent redetermination of the wavelengths of the [NI] transitions. The spectrophotometric records obtained for the Delbouille–Roland solar atlas reveal no trace of the four members of the infrared [NI] multiplet. In accord

with these observations, an estimate of the solar equivalent widths of the lines in question indicates that they are too weak to be discerned on the photometric tracings that are at present available. (auth)

24881 THE ASTRONOMER'S UNIVERSE. Mills, B. Y. (Univ. of Sydney). Austral. J. Sci., 29: 289-95(Mar. 1967).

Two recent discoveries are described which give promise of greatly extending an understanding of the nature and structure of the universe. The discovery and possible consequences of quasars are discussed in some detail, and it is concluded that neither the local nor cosmological interpretation can be supported with confidence. The recent discovery of an apparently isotropic very-low-temperature radiation is discussed which, it is thought, may be the remnants of an initial superdense state of radiation and matter. (W.D.M.)

24882 A NEW METHOD OF OBTAINING AN IONOSPHERIC INDEX OF SOLAR ACTIVITY FROM THE F2 LAYER CRITICAL FREQUENCIES. Huang, Chun-ming (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). Radio Sci., 2: 467-78(May 1967).

A new method of obtaining an ionospheric index of solar activity, based on the monthly median foF2 at 4 hours of the day (0, 6, 12, and 18 local hours) is described. The index for each month of the year has been determined, together with regression coefficients of quadratic equations for every hour at several typical stations, by minimizing the standard percentage error of foF2 estimates. The index has favorable features: the standard deviation of index above and below its running average is smaller; the standard percentage deviation of residual foF2 and the standard percentage deviation of total error in forecasts of foF2 are much smaller than those of the index obtained by the current method for calculating an ionospheric index of solar activity. Reasons for considering the new index a better approximation to an ideal solar index for the ionosphere are presented. (auth)

24883 PULSATING MODEL OF CLOSED UNIVERSE. Zaikov, R. G. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 9-11(1967).

The observations of Baum and Sandage during the last ten years indicate that the universe is finite, closed, and pulsating. Such a model of the universe has been suggested by the author (Comp. Rend. Acad. Bulg. Sci. 18, 1965, No. 7, 607). Hoyle and Narlikar (Proc. Roy. Soc., 290: 143(1966)) has introduced a time-dependent scalar field which interacts with usual matter in such a manner that a switch from contractions to expansion becomes possible. This scalar field is discussed in light of the author's previous work. (W.D.M.)

24884 INTERCOMPARISON OF NEUTRON MONITORS DURING SOLAR-FLARE INCREASES. Wilson, B. G.; Mathews, T.; Johnson, R. H. (Univ. of Calgary, Alberta). Phys. Rev. Lett., 18: 675-6(Apr. 17, 1967).

The energy spectrum of a solar-flare cosmic-ray increase is usually much steeper than that of galactic cosmic rays, and McCracken has pointed out the advantage of using two different absorption lengths for the two components present in a flare increase. A direct measurement of the absorption length of solar energetic particles detected by conventional neutron monitors is reported. (J.H.M.)

24885 RADIO WAVE SCATTERING ON ISOTROPIC AND RADIALLY EXTENDED INHOMOGENEITIES OF THE SOLAR OUTER CORONA. Vitkevich, V. V.; Lotova, N. A. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 493-9(1966).

Translated from Geomagn. Aeronomiya, 6: 650-7(1966).

Experimental data on the scattering of radio waves in the solar outer corona make it possible to distinguish in it two components of electron density inhomogeneities. The first consists of radially extended inhomogeneities and the second, of isotropic inhomogeneities. Formulas are derived for the scattering angles of a spherical wave on two components. It is found that a point radio source in the solar outer corona appears elliptical as a result of radio wave scattering. The major semiaxis of the ellipse is perpendicular to the direction toward the sun and its eccentricity depends on the coordinates of the source. (auth)

24886 PHOTOGRAPHY WITHOUT LENSES OR MIRRORS. Young, Niels O. (Block Associates, Inc., Cambridge, Mass.). Sky Telesc., 25: 8-9(Jan. 1963).

It is demonstrated how a reticle camera can be used to photograph celestial sources of x rays. Wide-angle photographs are shown which were taken with a camera that had no objective lens or mirror. The method can be used to map stars in the extreme uv and x ray regions, where ordinary lenses cannot be employed. The pictures shown were made from a 20-min exposure on Kodak Royal-X Pan film using a camera which is diagramed. In place of a lens is a specially marked mask, the reticle, which casts shadows on the film. The negative, a hologram, shows a series of geometrically similar patterns. The location of each corresponds to the direction of a star. How the confusion of images is sorted out so that the original distribution of stars in the field can be recognized is explained. Reconstruction depends upon the pattern of the reticle, an eccentric portion of a Fresnel zone plate, which can focus light like a lens. It is a circular diffraction grating whose spacing becomes smaller away from its center at just the rate needed to bring rays from a distant source to a focus. Therefore, to picture the original star field, the diffraction pattern of the hologram illuminated by coherent light is photographed. Each reticle pattern in the hologram acts independently of the others and, being a piece of a Fresnel plate, makes a bright spot in the reconstruction. The plate scale is the same as that of a camera whose focal length equals the distance of the reticle from the reconstruction. (BBB)

24887 HIGH-RESOLUTION STUDY OF SOME FRAUNHOFER LINES BY OBSERVATION OF THE OPTICAL RESONANCE OF AN ATOMIC JET. III. PERIODIC OSCILLATIONS OF THE LINES. Roddier, F. (Faculte des Sciences, Nice). Ann. Astrophys., 29: 639-44(Nov.-Dec. 1966). (In French).

The atomic beam spectrophotometer previously described was improved and used in the United States at Kitt Peak National Observatory. By using a higher magnetic field (22,000 G, instead of 12,000 G as used formerly) it was possible to explore the solar spectrum more extensively, including the Sr 4607 line and the Ca 4227 line. The oscillations of photospheric lines of the sun were observed and the period was found to be (300 ± 10 sec). These oscillations seem to be coherent on a surface of 10'' to 15'' of arc dia. The profile average evolution during an oscillation was obtained. The Sr 4607 line oscillates between a symmetrical profile at the expected wavelength and an asymmetric one shifted toward the violet. The base of the Ca 4227 line is formed in the transitional region between the photosphere and the chromosphere. Although the period is the same (300 sec) the nature of the oscillations is essentially different from those in the deeper layers. (BBB)

24888 SOLAR-EMITTED 40-keV ELECTRON STREAMS. Usp. Fiz. Nauk, 89: 307-8(June 1966). (In Russian).

Measurements on Mariner IV in May to June of 1965 at a distance of 1 astronomical unit (150 million km) from the earth and at a distance of 1.5 astronomical units from the sun showed the existence of three electron flares from the sun with the following intensities: 40, 80, and 2 cm^{-2} sec^{-1} $stere^{-1}$. The 40 keV electron flares lasted 1 to 2 days. Simultaneous measurements of radio emission from the sun and of solar x-ray flares showed that these emissions coincided in time with the 40 keV electron flares. (TTT)

Atomic and Molecular Physics

Refer also to abstracts 24268, 25263, and 25309.

24889 (CEA-Bib-89) CONSIDERATIONS GENERALES SUR LES METASTABLES. (General Considerations Concerning Metastable Species). Watel, Guy (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1967. 58p. (In French). Dep.

The metastable species are atoms, molecules, or ions in excited states whose lifetimes are sufficiently long for their return to ground states, under laboratory conditions, by the action of an outside phenomenon (electric or magnetic field, collision with other particles or the walls). This literature survey concerns the metastable atoms which have been most studied up to now: He, Ne, H, Hg, Ar, and Kr. (tr-auth)

24890 (N-67-12180) ANALYSIS OF LUNAR SURFACES. Final Report, February 1961-July 1965. Turkevich, Anthony (Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies). May 1966. 16p. (NASA-CR-75121; EFINS-66-49; EFINS-66-47). CFSTI $3.00 cy, $0.65 mn.

A method for chemical analysis of lunar and planetary material by use of alpha particles was investigated, and analytical procedures for an alpha-scattering experiment on a suitable lunar vehicle were developed. The method makes use of the interactions of a collimated beam of energetic, heavy, charged particles, with matter, to determine the chemical composition of the sample being analyzed. Fundamental studies on this method have been carried out in parallel with the development of instruments designed to meet the requirements of specific space missions. In discussing the results of these studies consideration is given to the scattering of alpha particles, the protons produced by alpha particles, the role of ionization energy loss by charged particles in interpreting the spectra of scattered alpha particles and protons, and an interpretation of complex spectra in terms of chemical composition.

Future prospects of the technique are also mentioned with particular emphasis slanted toward use on the Surveyor Lunar Mission. (STAR)

24891 (NASA-CR-759) ELECTRON SCATTERING AND BREMSSTRAHLUNG CROSS-SECTION MEASUREMENTS. Rester, D. H.; Dance, W. E. (Ling-Temco-Vought, Inc., Dallas, Tex.). Apr. 1967. 57p. CFSTI.

Angular distributions and spectra of electrons transmitted by Al and Au at an incident energy of 1.0 MeV were measured together with energy spectra of electrons backscattered by Al, Au, Fe, and Sn at 1.0 MeV. Cross sections for the production of bremsstrahlung in electron scattering by Al, Cu, Au, and Sn at 1.0 MeV and by Al at 1.7 and 2.5 MeV were also measured. (D.C.W.)

24892 (NYO-3708-04) A STUDY OF ALPHA PARTICLE REACTIONS IN ATMOSPHERIC GASES. Summary Progress Report No. 1, May 15, 1966–April 15, 1967. Fluegge, Robert A. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). Apr. 21, 1967. Contract AT(30-1)-3708. 20p. (CAL-VC-2279-P-04). Dep. CFSTI.

The first year of the program has been devoted primarily to reevaluating and modifying the experimental system, evaluating its performance, and determining its influence on the interpretation of data. As well, a literature review, to correlate these experiments with others, has been carried out. The equipment is functioning properly. The experiments use a mass spectrometer system developed to investigate radiative attachment processes. Primary and subsequent events that occur as a result of gas bombardment by alpha particles are being investigated. These experiments include the determination of ionization cross sections under electric field-free conditions, ion-molecule reactions that change the reactant's mass, and ionization probabilities by secondary electrons and by highly excited atoms. The experiments will concentrate on studying charged particle interactions with water vapor, due to the dominance of water in biological subjects. One of the major advantages of these experimental procedures is that they begin with the emission of a single particle, of known energy, into a reaction chamber where the particle is detected. Subsequent secondary interactions which it initiates in the reaction chamber can be observed. Since the processes start with a single particle, each series of events can be followed by sampling the number and mass of the ions after a predetermined reaction time has elapsed. Field-free conditions in the reaction chamber are achieved through the use of a pulsed system and the elimination of space charge effects that usually result when dense beams of charged particles are present. Accordingly, data that are collected under field-free conditions will help the radiation physicist to more accurately extrapolate low-pressure, ion–molecule reaction rates to normal, higher-pressure conditions. The mass spectrometer system includes an Am-241 alpha particle emitter; a fast, surface-barrier, solid-state detector; a reaction chamber surrounded by an ultrahigh vacuum system; a time-of-flight analyzer and charge separator; and a data handling system. (auth)

24893 EFFECT OF POLARIZATION ON THE ELASTIC ELECTRON SCATTERING BY HELIUM ATOM. Jha, R.; Banerjee, S. N.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 40: 543-8(Oct. 1966).

The S-wave phase shifts (η_0) in the elastic e–He scattering were calculated by Hulthen's (1944) variational method taking into account polarization effects due to the virtual excitation to 2^1S state, but neglecting exchange. The calculated phase-shift values compare favorably with those of Westin as quoted by Mott and Massey (1965). (auth)

24894 TRANSITION RADIATION FROM THIN FOILS DUE TO NON-NORMALLY INCIDENT ELECTRONS. Ashley, J. C. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 155: 208-10(Mar. 10, 1967). (ORNL-P-2518).

The results of an exact treatment of the transition radiation from a foil of arbitrary thickness bombarded by electrons at an arbitrary angle of incidence are presented. Several distributions of the radiation as calculated from the theory are given for Al and for Ag, as well as a comparison of theory with experimental results for the case of Ag. (auth)

24895 LIFETIME OF POSITRONS IN AN ELECTRON GAS. Carbotte, J. P. (McMaster Univ., Hamilton, Ont.). Phys. Rev., 155: 197-207(Mar. 10, 1967).

New estimates of the lifetime of a positron in an electron gas are presented. The discussion is based on a modified ladder-type approximation to the electron–positron Green's function chosen so that the displaced-charge sum rule is identically satisfied. This constitutes a refinement of the simple ladder sum used by Kahana, which leads to a large unphysical accumulation of charge about the positron. While this violation of the displaced-charge sum rule is, to say the least, annoying, reasons are given why it may not be very serious if one is concerned only with the computation of annihilation rates. It is found that the rates obtained in the more consistent modified ladder scheme are not very different from those quoted by Kahana although they represent a distinct improvement. (auth)

24896 MUON CAPTURE IN GAS MIXTURES. Budyashov, Yu. G.; Zinov, V. G.; Konin, A. D.; Mukhin, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 5: 830-3 (Apr. 1967). (In Russian).

The probability of muon capture by atoms in mixtures of monoatomic (He, Ne) and polyatomic (N, CO_2) gases was measured with respect to Ar by detecting the muonic x rays. No systematic dependence of the capture probability on the charge of the nucleus was observed. This could point to the large effect of the dimension of the molecules on the capture by atoms. (auth)

24897 NEW DETERMINATION OF THE X FLUORESCENCE YIELD OF THE K SHELL OF Cl. Pahor, Joze; Moljk, Anton (Stefan Nuclear Inst., Ljubljana, Yugoslavia. Univ., Ljubljana, Yugoslavia). Compt. Rend., Ser. B, 264: 550-2(Feb. 13, 1967). (In French).

The value found, deduced from the study of the decay of ^{37}Ar after electron capture, is $\omega_k = 0.0095 \pm 0.004$. It confirms that studied by other methods but differs from that given by the semi-empirical formula generally used. (tr-auth)

24898 TRANSITION RADIATION OF NONRELATIVISTIC ELECTRONS IN THIN GOLD FILMS. Arutyunyan, F. R.; Petrosyan, Zh. V.; Oganesyan, R. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 225-6(Sept. 1966).

Translated from Opt. Spektros., 21: 399-400(Sept. 1966).

Radiation resulting from the passage of electrons with energies of up to 60 keV through thin films of Au was investigated for the case when the electrons passed normally to the film surfaces. Experimental results on the spectral and angular distributions of this radiation and the dependence of the intensity on the electron energy are reported. The radiation was polarized in the plane of emission and the degree of polarization reached 89%. The absolute intensity of the observed radiation exceeded the theoretically expected value by a factor of 1.72. The results are compared with those previously obtained for Al films, and possible reasons for differences are considered. (A.G.W.)

24899 EFFECTIVE EXCITATION CROSS SECTIONS OF ALKALI-METAL ATOMS COLLIDING WITH SLOW ELECTRONS. V. RESONANCE LEVELS. Zapesochnyi, I. P.; Shimon, L. L. Opt. Spectros. (USSR) (Engl. Transl.), 21: 155-7(Sept. 1966).

Translated from Opt. Spektros., 21: 261-6(Sept. 1966).

A method for the determination of the absolute cross sections of the resonance lines of atoms is presented. The excitation cross sections of the resonance lines of potassium, rubidium, and cesium are measured, the role of successive transitions in the amplification of such lines is evaluated, and the excitation cross sections of the resonance lines of the investigated atoms are obtained. (auth)

24900 IONIZATION COEFFICIENT FOR METEORITIC ATOMS. Derbeneva, A. D. (Inst. of Astrophysics, Dushanbe, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 455-7(1966).

Translated from Geomagn. Aeronomiya, 6: 606-7(1966).

The ionization and diffusion cross sections for Ca, Fe, Si, and Mg collisions with atomic oxygen and nitrogen are computed. The computations are made according to the theory of Firsov which is based on the statistical Thomas–Fermi model. (J.H.M.)

24901 CALCULATION OF THE REDUCTION FACTOR OF THE SPACE CHARGE OF ELECTRON BEAMS MOVING IN PERIODIC ELECTROSTATIC FIELDS. Meshkov, O. F. Radiotekh. Elektron., 11: 2176-85(Dec. 1966). (In Russian).

Calculations were made of the field reduction coefficient for various configurations (ring, solid cylindrical, or band-shaped) of electron beams moving in arbitrary periodic electrostatic fields. (tr-auth)

24902 KINETICS OF ELECTRON RECOMBINATION IN MOLECULAR GAS PROPAGATING INTO A VACUUM. Kuznetsov, M. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 42-9(Sept.-Oct. 1966). (In Russian).

Kinematics of a diatomic and multiatomic gas propagating into a vacuum is considered. Recombination, dissociation, and charge-exchange reactions with account of the negative ions are included in the derived rate formulas. This study is modeled on the monoatomic theory of explosive gas flow and the similar and distinguishing characteristics of the two theories are enumerated. The time-dependent concentrations of charged particles in the ionized nonequilibrium gas are expressed by quadratures for known reac-

tion rates. In addition, the instant of the departure of electrons and negative and positive ions from equilibrium is obtained. It is shown that even in cases where reaction rates are known within an order of magnitude, a good prediction of the equilibrium state is possible since departure from equilibrium is relative to the positive ions, while electrons and negative ions remain in equilibrium considerably longer. (ATD)

24903 PRODUCTION OF IONS AND ION CURRENT IN A MODULATED ELECTRON BEAM. Zhigailo, B. A.; Zinchenko, N. S. (Inst. of Radiophysics and Electronics, Kharkov). Zh. Tekh. Fiz., 36: 2136-44(Dec. 1966). (In Russian).

It was earlier shown that velocity modulation of an electron beam can lead to increased ionization of the residual gas by the beam, owing to the nonlinear dependence of the ionization cross section on the electron velocity. This process is treated quantitatively. The basic equations for the treatment of the problem are obtained with the aid of the following simplifying assumptions: the electron beam is infinitely broad (i.e., the problem is treated as one-dimensional); there are no electric fields in the space between the modulating gap and the collector; the effect of space charge on the motion of the electrons, scattering of the electrons by residual gas molecules, and slow secondary electrons are all negligible; and multiple ionization processes contribute negligibly. Further approximations are introduced in the solution of the equations. The velocity dependence of the ionization cross section is represented by an empirical formula, and expressions are derived for the ion current and density. These quantities are found to depend on the modulation factor, the accelerating potential, the static transit angle of the electrons in the modulating gap, and the modulation frequency. Numerical solutions were obtained for the case when the residual gas is nitrogen. These solutions were computed for accelerating potentials from 300 to 1500 V, for the full range of modulation factors from 0 to 1, and for a number of different transit angles; the results are presented as curves showing the ratio of the ion current or density to the corresponding quantity for an unmodulated beam as functions of one of the parameters for fixed values of the other parameters. Under some conditions (in particular, for zero transit angle) the ion current is maximum for a certain modulation factor less than unity. The ion current is a rather complex function of the transit angle, having three maxima and three minima. A few experimental points are shown on some of the curves. (ATD)

24904 MEASUREMENT OF THE LINEAR ACCELERATION OF CHARGE CARRIERS IN ALTERNATING ELECTROMAGNETIC FIELDS. Preibisch, H. (Technische Hochschule, Munich). Z. Angew. Phys., 22: 493-6(1967). (In German).

Charged particles are observed in alternating crossed electromagnetic fields having a phase shift of 90° between the electric and magnetic component. In such fields the charged particles are accelerated linearly in a direction perpendicular to E and B. For cesium ions the amount of this acceleration was measured in high vacuum working at frequencies of 240 and 600 kc. The measured acceleration agrees well with the theoretically predicted one. (auth)

24905 ABSOLUTE MEASUREMENT OF THE BREMSSTRAHLUNG SPECTRA IN THICK ANODES IN THE ENERGY REGION AT 500 keV. Jakschik, J. (Freie Univ., Berlin). Z. Angew. Phys., 22: 510-16(1967). (In German).

Absolute spectra and spatial thick-target bremsstrahlung distribution measurements for different atomic numbers of the target material in the energy region of 0.5 MeV with a scintillation spectrometer are described. Distortions due to counting losses, background, and photon absorption in the target are eliminated. Integration of the results over the whole photon angle allowed comparison with Kramer's formula. For the average total radiation loss per incident electron divided by atomic number Z a systematic dependence on Z is estimated. The determined efficiencies for bremsstrahlung production are compared with calculations of Kirkpatrick and an empirical formula of Jaeger. (auth)

24906 TOWNSEND ENERGY COEFFICIENTS FOR ELECTRON SWARMS IN POLYATOMIC GASES. Cottrell, T. L.; Walker, Isobel C. (Univ. of Edinburgh). Trans. Faraday Soc., 63: 549-54(Mar. 1967).

Townsend's energy coefficient k was measured as a function of E/P for electrons in CH_4, CD_4, SiH_4, SiD_4, C_2H_6, C_2H_3, and CH_3OCH_3. The results are used in conjunction with previously determined electron drift velocities to evaluate Q_D, the electron/molecule momentum transfer cross section, and λ, the fractional energy lost by an electron in a collision with a gas molecule. These are discussed in terms of low-energy resonances between electrons and molecules. (auth)

24907 IONIZER WITH A THREE-ELECTRODE ELECTRON GUN AND IONIZING EFFICIENCY OF 0.002. Slabospitskii, R. P.; Karnaukhov, I. M.; Kiselev, I. E. Zh. Tekh. Fiz., 36: 2145-7(Dec. 1966). (In Russian).

An electron beam ionizer suitable for use in a source of polarized ions is described. In this ionizer, the atomic beam to be ionized traverses the device axially, passing through central openings in the cathode, the first and second anodes, and the electron collector. The Faraday cup mounted 15 cm beyond the collector served to measure the beam current during the experimental work. The first anode is made some 3000-V positive with respect to the cathode, thus assuring maximum electron emission. The electrons are decelerated in the gap between the two anodes to the optimum energy for ionization of the atomic beam (some 400 or 500 eV). Calculations indicate that the second anode should increase the ionization efficiency by a factor of 5 or 6. The electron optics were such that when the collector and the Faraday cage were at the some potential, 95% of the electrons passed throught the first anode, 90% of them passed through the second anode, and 70% of the cathode current was collected in the Faraday cup. The currents to the several electrodes are presented graphically as functions of the second anode potential, and the curves are discussed briefly. The optimum conditions for ionization of an atomic beam were also determined experimentally and are presented graphically. (ATD)

24908 DISSOCIATION OF SINGLY CHARGED POSITIVE CD SUB 5, CH SUB 5, AND CD SUB 4 IONS BY COLLISION WITH NEON ATOMS AND AIR MOLECULES. Kupriyanov, S. E. (Scientific Research Physicochemical Inst., Moscow). Zh. Tekh. Fiz., 36: 2161-3(Dec. 1966). (In Russian).

A double mass spectrometer was used to measure the cross sections of argon atoms and air molecules for dissociation of CD_5^+, CH_5^+, and CD_4^+ ions. Only the CD_5^+ and CD_4^+ data are reported and discussed. The CD_5^+ ions were obtained by electron-impact ionization of CD_4, and CD_5^+ ions were obtained by reaction of CD_4^+ ions with CD_4. The cross sections of neon atoms and air molecules for a number of different possible dissociation processes were measured and are tabulated. The two cross sections (argon and air) for each different process were very nearly equal. The total dissociation cross section was 1.6×10^{-16} cm^2 for CD_5 and 3.3×10^{-16} cm^2 for CD_4^+. The fluxes of the several dissociation products were proportional to the pressure in the scattering chamber. This indicates that the data relate to single collisions, and that both CD_4^+ and CD_5^+ are stable. It is noted that very short-lived unstable CD_4^+ ions might escape detection in the present experiments because some 6 microseconds were required for an ion to traverse the second analyzer of the mass spectrometer. The fact that the dissociation cross section for CD_4^+ is greater than that for CD_5^+ is discussed briefly, and it is suggested that in addition to the C–D bonds, there may be significant forces between the D atoms in CD_5^+. (ATD)

24909 ATOMIC ABSORPTION CROSS SECTIONS OF LITHIUM AND SODIUM BETWEEN 600 AND 1000 A. Hudson, R. D.; Carter, Virginia L. (Aerospace Corp., Los Angeles). J. Opt. Soc. Amer., 57: 651-4(May 1967).

The continuous atomic-absorption cross section of lithium and sodium vapors has been measured between 600 and 1000 Å using photoelectric techniques. Curves and tables are presented of the atomic-absorption cross section versus energy from their series limits to 600 Å. A comparison is made between these results and recent theoretical estimates. The conclusion is that theory and experiment are in poor agreement for sodium at photon energies above 7 eV. (auth)

24910 ANGULAR CORRELATION OF ANNIHILATION RADIATION FROM POSITRON ANNIHILATION IN COPPER. Wang, Ai-lan Chen (National Taiwan Univ., Taipei, Taiwan). Chin. J. Phys. (Taiwan), 4: 71-4(Oct. 1966).

The angular correlation of two-gamma-ray radiation from positron annihilation in copper has been observed and an angular correlation curve has been drawn. The momentum distribution and density distribution curves have been drawn and discussed. It is found that these curves resemble those found by other methods for the conduction electrons alone. An inflection has been found in the momentum distribution curve in a position about one degree from zero deviation; it corresponds to the discrete part in the density distribution curve in the momentum space. (auth)

24911 THERMAL CONDUCTIVITY OF HYDROGEN–HELIUM GAS MIXTURES. Mukhopadhyay, P.; Barua, A. K. (Indian Association for the Cultivation of Science, Calcutta). Brit. J. Appl. Phys., 18: 635-40(May 1967).

The thermal conductivity of hydrogen–helium gas mixtures was measured by the thick-wire variant of the hot-wire method over the temperature range from −183 to 200°C. The results confirm the recently reported appearance of a minimum in the plot of conductivity against composition. An attempt is made to explain the anomaly as due to relaxation effects in the hydrogen and helium interactions. (auth)

24912 THERMIONIC EMISSION OF ALKALI IONS FROM IMPREGNATED METAL MATRICES. Chow, K. K.; Maddix, H. S.; Chorney, P. (Microwave Associates, Inc., Burlington, Mass.). Appl. Phys. Lett., 10: 256-8(May 1, 1967).

Thermionic emission of alkali metal ions from matrices composed of sintered mixtures of aluminosilicate and metal powders are studied. Results show that the emission characteristics depend on temperature, effective work function, and voltage in a similar way as does electron emission. The effective work function for these composite emitters varies between 1.1 and 3.4 eV. Short-term continuous emission densities up to 4.5 mA/cm^2 have been obtained. (auth)

24913 KINETIC ENERGY OF FRAGMENT IONS PRODUCED BY ELECTRON IMPACT. Clampitt, R.; Dunning, W. J. (Univ. of Bristol, Eng.). J. Sci. Instrum., 44: 336-42(May 1967).

A retarding-potential technique was used to ascertain the presence or absence of initial kinetic energy in positively charged fragment ions near their appearance potentials in order to confirm or correct current values of bond dissociation energies, heats of formation, and electron affinities. The mass spectrometer was an AEI type MS2-H; ions emerging from the source are focused at a beam-defining slit to which a retarding potential is applied. Ions having sufficient kinetic energy to surmount the potential barrier at the slit are transmitted, accelerated to ground potential, and subsequently mass-analysed by the sector field. Several factors influencing the shape of the retarding-potential curves are discussed. Theoretical curves are derived for ions formed with a discrete amount of kinetic energy, and these are compared with experimental curves. An attempt is made to reinforce, with kinetic energy data, measurements on excited states of fragment ions. The following ions were studied: O^+, O^{2+} (O_2); Cl^+ (Cl_2); I^+ (I_2); CH_3^+, I^+, (CH_3I); CH_3^+, CN^+ (CH_3CN); C^+, O^+, CO^+ (CO_2); N^+ (N_2); C^+, CH^+, CH_2^+, CH_3^+ (CH_4). It was found that none of the singly charged ions possessed a significant amount of kinetic energy near to their lowest threshold potentials; the ion O^{2+} (O_2) possessed not less than 2.5 eV of kinetic energy near its appearance potential. (auth)

24914 EXTENSION OF THE PATH-LENGTH FORMALISM TO ANISOTROPIC CHARGED-PARTICLE SOURCES. Lewis, E. E. (Inst. for Exploratory Research, Army Electronics Command, Fort Monmouth, N. J.). Nucl. Sci. Eng., 28: 311-12(May 1967).

Path-length distributions are calculated as a function of angle for heavy charged particles emitted from anisotropic sources. (D.C.W.)

24915 SCATTERING OF ELECTRONS BY HEAVY ATOMS. Vyazigin, A. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 368-71(Dec. 1966).

Translated from Opt. Spektros., 21: 666-72(Dec. 1966).

A method based on the self-consistent field method is proposed for calculating the mean-square radii of heavy atoms, which determine scattering at small angles. The mean-square radii of atoms calculated by this method are compared with those calculated from the Thomas–Fermi and Slater models. The scattering of electrons at small angles plays an important role in the formation of the image in the electron microscope. (auth)

24916 CROSS SECTIONS FOR THE EXCITATION OF MOLECULAR NITROGEN LEVELS BY ELECTRON COLLISION. Zapesochnyi, I. P.; Skubenich, V. V. Opt. Spectros. (USSR) (Engl. Transl.), 21: 83(July 1966).

Translated from Opt. Spektros., 21: 140-1(July 1966).

The excitation cross sections of about 120 bands belonging to the first and second positive systems of the N_2 molecule, the Meynell system, and the first negative system of the molecular N_2^+ ion were measured for electron energies from the excitation threshold to 100 to 140 eV. It was found that the levels of the neutral nitrogen molecule are excited most efficiently by electrons in the 10- to 20-eV range. The states of the molecular N_2^+ ion have a maximum excitation probability over a range of electron energies from 30 to 100 eV. (A.G.W.)

24917 USE OF COMPLEX POTENTIALS IN THE THEORY OF ELECTRON-ATOM COLLISIONS. Obedkov, V. D. Opt. Spectros. (USSR) (Engl. Transl.), 21: 1-3(July 1966).

Translated from Opt. Spektros., 21: 3-7(July 1966).

A complex potential of the form $V = V_0 - (i/k)\bar{V}_1$ is introduced, which describes the scattering of electrons by atoms when $k > 1$. The use of this potential in the framework of the first Born approximation is equivalent to a certain degree of the direct calculation of the amplitude of scattering in the second Born approximation. (auth)

24918 DETERMINATION OF ABSOLUTE OSCILLATION STRENGTH OF THREE RESONANCE LINES OF TITANIUM. Reinke, Peter (Univ., Kiel). Z. Astrophys., 66: 234-45(1967). (In German).

From absorption measurements in an atomic beam, absolute oscillator strengths were obtained for three TiI resonance lines using the curve of growth. The results were f(λ 3635) = 0.157, f(λ 3643) = 0.135, and f(λ 3654) = 0.128. The density in the atomic beam was derived from the chemically determined mass of the titanium atoms deposited during the measurement and from their mean velocity. (auth)

24919 DAMPING OF WAVES IN ELECTRON BEAMS. Caulton, Martin (RCA Labs., Princeton, N. J.). J. Appl. Phys., 38: 1839-55(Mar. 15, 1967).

The damping of plasma oscillations in velocity-modulated electron beams with large-velocity spreads was analyzed. It is shown that the observed spatial decay of rf current along the beam (a loss of the fundamental interference pattern) can be characterized by the exponential decay of one of the space-charge waves. The exponential-decay rates for this wave are extracted from the data of over 50 experiments which exhibited a spatial damping. The parameters of the measured "near-Maxwellian" distribution of velocities (cutoff with a slow "tail") associated with each decay lead to the characterization of an equivalent temperature for the beam condition of each experiment. This is used to calculate the damping-determining parameters (ratio of plasma wavenumber to Debye wavenumber, k/k_D, or equivalent). The experimentally observed damping rates for a variety of beam conditions are found to vary with k/k_D in a consistent fashion and are also comparable with rates extracted from electron-beam theories. This is interpreted as a demonstration of a damping mechanism without collisions, and leads to the ascription of the decay as Landau damping in electron beams. Further experiments, in which the decay is observed as a function of the driving amplitude of the electron-beam plasma oscillations, are studied as possible evidence of Landau damping in electron beams. (auth)

24920 RADIATION-FIELD-DEPENDENT FREQUENCY SHIFTS OF ATOMIC BEAM RESONANCES. Harrach, Robert J. (National Bureau of Standards, Boulder, Colo.). J. Appl. Phys., 38: 1808-19(Mar. 15, 1967).

Radiation-field-dependent frequency shifts arising in atomic-beam spectroscopy are treated theoretically and experimentally. Shifts due to fundamental and unavoidable interactions between the radiation field and the atoms comprising the beam are distinguished from those due to various "apparatus effects." Precise measurements of frequency shifts are made for a cesium beam experiencing Ramsey-type excitation. For the magnetic-field-sensitive transitions $(F, M_F) = (4, \pm 1) \rightleftharpoons (3, \pm 1)$, the magnitude of the shifts is about 1 part in 10^{10} of the resonance frequency value, per milliwatt variation of input power to the radiation field. The shifts vary with input intensity in a nonmonotonic fashion and are shown to result from nonuniformity in the static magnetic c-field of the apparatus. Much smaller shifts of about 5 parts in 10^{13} per milliwatt are observed for the magnetic-field-insensitive transition $(F, M_F) = (4,0) \rightleftharpoons (3,0)$. The major features of these shifts are shown to arise from spectral impurities in the radiation exciting the transition and a small phase difference between the pair of separated radiation fields. The bearing these results have on evaluating the accuracy of an atomic beam frequency standard is discussed. (auth)

24921 LOW-ENERGY SPUTTERING YIELDS OF Ge SINGLE CRYSTALS AS A FUNCTION OF TEMPERATURE. Anderson, G. S. (Litton Systems, Inc., Minneapolis). Contract AT(11-1)-722. J. Appl. Phys., 38: 1607-11(Mar. 15, 1967).

The temperature dependence of the relative sputtering yields of Ge (100, (110), and (111) surfaces for various kinds of noble gas bombarding ions, bombarding ion energies, and bombarding ion fluxes was investigated. Instantaneous relative yields were obtained by using the spectroscopic emission technique. The dependence of the annealing temperature on the bombarding ion energy and flux can be interpreted in terms of a simplified model where the rate of defect production equals the rate of defect annealing at the annealing temperature. The width of the transition region increases with decreasing bombarding ion energy and mass. (auth)

24922 RELATIVE INTENSITIES AND LINE WIDTHS OF X RAYS: $K\beta_2^I$, $K\beta_2^{II}$. Raffray, Y. (Faculte des Sciences, Nantes, France). J. Phys. (Paris), 27: 657-9(Nov.–Dec. 1966). (In French).

Transition probabilities, relative intensities, and line widths of $K\beta_2^I$–$K\beta_2^{II}$ were calculated for a few values of Z. Results obtained using wave functions with Slater screening coefficients are in good agreement with the measurements of O. Beckmann. (auth)

24923 CHARGE TRANSFER BETWEEN He^+ AND N_2. Inn, Edward C. Y. (Ames Research Center, Moffett Field, Calif.). Planet. Space Sci., 15: 19-25(Jan. 1967).

Emission of several bands of the second negative system of N_2^+ has been observed in mixtures of N_2 with afterglowing He. The emission follows charge transfer between He^+ and N_2; the relevant rate coefficient is estimated to be about (1 to 0.05) × 10^{-9} cm^3 sec^{-1} at thermal energy. It is predicted that the radiative sequence is a source of an uv airglow in the region of the maximum of the He^+ layer in the upper atmosphere. A conservative estimate of the airglow emission rate of the (3,9) band of the second negative system of N_2^+ is calculated to be about 5 R. (UK)

24924 POSSIBILITY OF PHOTODETACHMENT IN THE IMPULSE BREAKDOWN OF POSITIVE POINT–PLANE GAPS IN AIR. Boylett, F. D. A.; Williams, B. G. (Central Electricity Generating Board, Leatherhead, Eng.). Brit. J. Appl. Phys., 18: 593-5(May 1967).

The relative importance of the roles of photodetachment and photoionization in the propagation of positive point–plane impulse corona in air is discussed. Consideration of the magnitudes of the cross sections for the two mechanisms as a function of photon energy reveals a higher efficiency for the photodetachment process. Further support for the conclusion that photodetachment is more probable than photoionization, in the circumstances considered, is drawn from experimental evidence, such as the visual form of the corona and its dependence upon meteorological conditions. (auth)

24925 APPROXIMATION BETTER THAN THE DISTORTED WAVES APPROXIMATION. Kolodziejski, R. (Inst. of Physics, Warsaw). Acta Phys. Pol., 31: 783-6(Apr. 1967).

Several steps are given of a procedure by which the first three partial cross sections were calculated for 1s–2s excitation of atomic hydrogen by impact with 30.61 eV electrons. The main advantage of the procedure is the possibility of constructing new sets of a bound electron's wave functions. The results are compared with values calculated by other methods. (A.G.W.)

24926 ATOMIC POLARIZABILITIES AND SHIELDING FACTORS IN THE CASE OF OPEN SHELLS OF ELECTRONIC SYSTEMS. Malinowski, S. (Univ. of Lodz, Poland). Acta Phys. Pol., 31: 641-52(Apr. 1967).

A method is derived for calculating the atomic polarizabilities $\alpha_2 L$ and the shielding factor $\gamma_2 L$ in the case of open shells of atoms and ions by means of uncoupled approximation using the Roothaan procedure. (auth)

24927 ATOMIC POLARIZABILITIES AND SHIELDING FACTORS IN THE CASE OF UNCOUPLED HARTREE–FOCK APPROXIMATION FOR THE ATOMS AND IONS IN $^1S_0$ STATE. Malinowski, S. (Univ. of Lodz, Poland). Acta Phys. Pol., 31: 603-12(Apr. 1967).

A method for calculating the multipole polarizability $\alpha_2 L$ and the shielding factor $\gamma_2 L$ in the uncoupled Hartree–Fock approximation is presented. The proposed method is a remarkable simplification of the Dalgarno method. It makes it possible to write down $\alpha_2 L$, $\gamma_2 L$ explicitly by means of radial integrals. (auth)

24928 PHYSICAL PROPERTIES OF MANY-ELECTRON ATOMIC SYSTEMS EVALUATED FROM ANALYTICAL HARTREE-FOCK FUNCTIONS. V. MAGNETIC HYPERFINE STRUCTURE CONSTANTS. Malli, Gulzari (Simon Fraser Univ., Burnaby, B. C.). Fraga, Serafin. Theor. Chim. Acta, 7: 75-9(1967).

Available Hartree–Fock functions were used to evaluate the magnetic hyperfine structure constants for various neutral atoms and positive and negative ions with configurations involving equivalent p and d electrons. The necessary formulation is presented; in particular, the J dependence of the hyperfine structure constant is tabulated for the mentioned configurations. It is concluded that, in general, Hartree–Fock functions are adequate for the evaluation of magnetic dipole hyperfine structure constants. Any discrepancy found must be probably on account of an error in the experimental values, either of the constants or of the corresponding nuclear moment. The accuracy of the calculated value of the constants seems to be independent of Z; for ^{11}B the error was 4% and for ^{79}Br and ^{81}Br, the heaviest atoms considered here, the discrepancy with the experimental value was 5%. On the other hand, the Hartree–Fock functions used seemed to be satisfactory because the calculated value for ^{35}Cl had only an error of 4%. (BBB)

24929 PHYSICAL PROPERTIES OF MANY-ELECTRON ATOMIC SYSTEMS EVALUATED FROM ANALYTICAL HARTREE-FOCK FUNCTIONS. VI. SPIN-ORBIT COUPLING CONSTANTS. Malli, Gulzari (Simon Fraser Univ., Burnaby, B. C.); Fraga, Serafin. Theor. Chim. Acta, 7: 80-4(1967).

Spin–orbit coupling constants were evaluated using analytical Hartree–Fock functions for a large number of atomic systems. The values of the spin–orbit interaction constants for various states of positive ions, neutral atoms, and negative ions with p^n and d^n configurations are presented in a table. For comparison the corresponding experimental values are also presented. The experimental values of the spin–orbit coupling constants (λ) were determined by the relation: $\lambda J = E(J) - E(J-1)$, using the E(J) values given by Moore (Nat. Bureau Standards, Circ. No. 467 (1949)). Inspection of these tables showed that the agreement is reasonably good between the theoretical and experimental values of the spin–orbit coupling constants. (BBB)

24930 FREQUENCY MULTIPLICATION IN AN ELECTROSTATIC MULTIPOLE FIELD. Berghammer, Johannes; Linn, Hans-Jochen; Poeschl, Klaus; Seunik, Horst (Siemens-Schuckertwerke AG, Munich). Arch. Elek. Uebertr., 17: 345-50(1963). (In German).

Frequency multiplication was applied to a transversally modulated electron beam in a multipole field. Theoretical examination of the motion of an electron beam modulated transversally in the form of a synchronous wave in an electrostatic 2n-pole field ($n > 2$) indicated that multiples of the fundamental (ω) appear, namely the frequencies $(n-1)\omega$, $(n+1)\omega$, $(2n-1)\omega$, $(2n+1)\omega$, etc. The nonlinear equation of motion was solved approximately by analysis and also numerically on a digital computer. The amplitudes associated with all appearing frequencies increase with distance, and the amplitudes of the harmonics generated in the multipole field may exceed the input amplitude of the fundamental. The processes are practically limited by the required multipole field strength and the large excursions of the electrons accompanied by the increase of the strength of the harmonics. The frequency multiplication is independent of the input frequency and includes the possibility of a conversion gain. (BBB)

24931 LOW-ENERGY SCATTERING OF ELECTRONS BY THOMAS–FERMI ATOMS. Malinowska-Adamska, C. (Technical Univ., Lodz, Poland). Acta Phys. Pol., 31: 721-5(Apr. 1967).

An analytical expression is given for the total cross section δ for low-energy electron scattering by Thomas–Fermi atoms. Results are compared with other theoretical and experimental data. (auth)

24932 ONE AND TWO ELECTRON LOSS CROSS SECTIONS OF H^- IONS IN CO_2 OR N_2 GAS. Kovacs, I. (Central Research Inst. for Physics, Budapest). Nucl. Instrum. Methods, 51: 224-8(May 1967).

Measurements of the cross section for the loss of one (σ_{-10}) and two (σ_{-11}) electrons by H^- ions in CO_2 or N_2 gas at ion energies from 200 keV to 500 keV are reported. The cross sections were determined by analysis of the three-component beam after passing a gas target. The electron loss cross sections evaluated in this way are $\sigma_{-11} = 14.7 \times 10^{-17}$ cm^2/N atom – 5.9×10^{-17} cm^2/N atom, $\sigma_{-10} = 38.7 \times 10^{-17}$ cm^2/N atom – 24.0×10^{-17} cm^2/N atom for N_2 gas, $\sigma_{-11} = 75.9 \times 10^{-17}$ cm^2/CO_2 molecule – 23.5×10^{-17} cm^2/CO_2 molecule and $\sigma_{-10} = 147.1 \times 10^{-17}$ cm^2/CO_2 molecule – 82.4×10^{-17} cm^2/CO_2 molecule for CO_2 gas. The cross sections for electron loss decrease monotonically with increasing ion energies in the energy range covered by the measurements. (auth)

24933 PROBLEM OF THE RIBBON ELECTRON BEAM COMPRESSION BY A MAGNETIC FIELD. Bur'yanov, P. D. Radiotekh. Elektron., 11: 1711-12(Sept. 1966). (In Russian).

Ribbon electron beam compression by a magnetic field was studied, considering a uniform beam motion in a constant potential space along the axis Z and magnetic induction variations along the axis Z, according to $B_z = B_{0z} e^{\alpha Z}$ (where B_{0z} is a longitudinal component of the magnetic induction at a potential space ($Z = 0$), and α is the coefficient of rising magnetic induction per unit along the axis Z). The calculations indicated that the electron beam compression can be achieved by increased magnetic induction along the axis Z. The beam compression of a fully screened cathode ($B_k = 0$) is larger than for partially or non-screened cathodes. (R.V.J.)

24934 SCATTERING MATRIX ANALYSIS OF ANISOTROPIC ELECTRON SCATTERING. Boardman, A. D. (Univ. of Salford, Eng.); Hill, A. D.; Sampanthar, S. Phys. Lett., 24A: 447-8 (Apr. 24, 1967).

Formulas are presented for the momentum transfer cross section of an elastic particle incident perpendicular and parallel, respectively, to the axis of symmetry of a point dipole potential. (auth)

24935 SPECTROSCOPIC STUDY OF MOLECULAR HYDROGEN ABOVE ITS FIRST IONIZATION POTENTIAL. Comes, F. J. (Univ., Bonn). Phys. Lett., 24A: 465-6(Apr. 24, 1967).

Differences in the absorption and ionization cross section of H_2 are measured with the aid of the Hopfield continuum. (auth)

24936 PULSATION OF A BOUNDARY OF A HOLLOW CYLINDRICAL ELECTRON STREAM AT ITS FOCUSING BY AN AX-

IALLY SYMMETRIC MAGNETIC FIELD. Bakhrakh, L. E.; Kozel, I. Sh. Radiotekh. Elektron., 11: 1707-10(Sept. 1966). (In Russian).

Calculations were made using equations of motion for a radial boundary electron beam assuming that the beam is paraxial, and is moving at a constant axial rate, with a uniform distribution of the space charge across the beam cross section. Comparisons of the beam focusing in homogeneous and in periodic magnetic fields showed that, in both cases, a coordinated selection of the electron beam parameters, magnetic field, and conditions of the beam injection into the focusing system could produce optimum focusing. Under optimum conditions, the electron beam boundaries in a constant magnetic field were smooth and in a periodic field they were wavy; however, the beam boundaries became smoother with a reduced parameter α. (R.V.J.)

24937 CONTRIBUTION TO THE THEORY OF NEGATIVE ION FORMATION IN SLOW ATOMIC COLLISIONS. Vitlina, R. Z.; Chaplik, A. V. Zh. Eksp. Teor. Fiz., 52: 959-65(1967). (In Russian).

The effect of a nonstationary perturbation on an electron which results at a certain time in the appearance of a bound S state is considered. The capture probability and distribution in the continuous spectrum are found in the adiabatic approximation. The relation between this problem and that of formation of negative ions in slow collisions is demonstrated. (auth)

24938 IONIZATION OF THE HYDROGEN ATOM BY ELECTRON IMPACT IN THE THREE-BODY APPROXIMATION OF CLASSICAL MECHANICS. Brattsev, V. F.; Ochkur, V. I. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz., 52: 955-8(1967). (In Russian).

It is shown that the shape of the ionization function as well as the absolute values of the cross sections can be considerably improved by taking into account all interactions. The remaining discrepancy may be considered as a measure of the error of the classical description. With aid of the calculated cross sections and by a simple change of scale one can obtain ionization cross sections for an excited atom of arbitrary degree of excitation. (auth)

24939 EXCITATION OF THE HYDROGEN ATOM BY FAST ELECTRONS IN THE OCHKUR APPROXIMATION. Inokuti, Mitio (Argonne National Lab., Ill.). J. Phys. Soc. Jap., 22: 971-3(Apr. 1967).

An approximation, recently devised by Ochkur to take into account exchange effect in scattering of fast electrons by an atom, was applied to excitation of the 2s and 2p levels of the hydrogen atom. The resulting cross sections are fairly close to the presently most reliable results of a close-coupling treatment. (auth)

24940 EFFECT OF RADIATION REACTION ON THE NONLINEAR SCATTERING OF ELECTROMAGNETIC WAVES BY FREE ELECTRONS. Prakash, H. (Univ. of Allahabad, India). Phys. Lett., 24A: 492-3(Apr. 24, 1967).

It is shown that the radiation reaction due to which an electron gains, in an instantly switched radiation, an additional average momentum depending on the initial phase of the radiation and an average acceleration, gives important contributions to the nonlinear effects in Thomson scattering. (auth)

24941 SLOW-ELECTRON SCATTERING BY STRONGLY POLAR MOLECULES. Itikawa, Y. (Tokyo Univ.). Phys. Lett., 24A: 495-6(Apr. 24, 1967).

The cross section for electron scattering by a polar molecule is calculated taking into account the temporary capture of the electron in the dipole field of the molecule. If the dipole moment of the molecule is relatively large, the cross section is enhanced due to the capture process. (auth)

Cosmic Radiation

Refer also to abstracts 24202 and 24884.

24942 (BSR-2018) COSMIC RAY. Final Report, January 23, 1966-January 23, 1967. Wainio, K. M. (Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.). Feb. 23, 1967. Contract AF19 (628)-5840. 61p. (AFCRL-67-0149).

Results of calculations to determine specific yield functions for IGY neutron monitors are reported for vertically incident cosmic-ray protons in the range of $1 < P_c < 6$ GV. The Monte Carlo method is used to calculate secondary nucleon flux intensities at atmospheric depths of 312, 680, and 1000 g/cm^2. Experimental data on neutron monitor response are employed to relate the calculated flux data to count rates, and hence to specific yields, at the corresponding depths. Comparison with empirical data for the specific yield function at sea level shows fair agreement for rigidities less than 3 GV, but calculated yields are considerably smaller than the empirical data at higher rigidities. Various possible explanations for the discrepancy are discussed. At this time, the most probable cause appears to be the assumption that vertically incident cosmic rays produce most of the counts registered by neutron monitors. (auth)

24943 (NP-tr-1521) MEASUREMENT OF THE SECONDARY GAMMA SPECTRUM FROM 0.2 TO 2 GeV IN THE UPPER ATMOSPHERE. Koehn, D.; Pinkau, K.; Wibberenz, G. Translated by R. A. Slingo (Atomic Energy Research Establishment, Harwell, Eng.), from Z. Phys., 193: 443-58(1966). 25p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $3.60 fs, $1.30 mf.

A balloon experiment was carried out to measure the energy spectrum of photons between about 100 and 2000 MeV, using a lead-scintillator-sandwich spectrometer. The energy calibration of this instrument was performed theoretically, utilizing Nagel's Monte Carlo calculations. The results of a test flight carried out from Meppen (cutoff 2.5 GeV) on October 19, 1963, showed: (1) the attenuation length of atmospheric photons of several hundred MeV increases with depth beyond the transition maximum, and (2) the integral intensity of photons at an average altitude of 355 g/cm^2 is $I(\geq 200\ \text{MeV}) = 3.6 \times 10^{-2}\ \text{cm}^{-2}\ \text{sec}^{-1}\ \text{sterad}^{-1}$. The shape of the energy spectrum was obtained. It may be approximated by a power law $E^{-1.3\pm0.2}$ between 500 and 2000 MeV. A comparison of the results was made with measurements of other authors. It is possible to construct a differential γ-ray spectrum at a depth of 7 g/cm^2 indicating a possible minimum at about 20 MeV followed by a maximum at about 70 MeV. (auth)

24944 OPACITY OF THE UNIVERSE TO HIGH-ENERGY PHOTONS. Gould, Robert J.; Schreder, Gerard P. (Univ. of California, San Diego, La Jolla). Phys. Rev., 155: 1408-11 (Mar. 25, 1967).

Based on observational data, the spectra of cosmic radio, microwave, infrared, optical, and x-ray photons are estimated. The absorption probability per unit path length by the process of pair production in photon-photon collisions is then computed as a function of energy for high-energy photons traversing this photon gas, using the results of a previous paper. These calculations show that there should be a dip in the intensity of the high-energy cosmic photon spectrum by about a factor of 10 between 10^{12} and 10^{13} eV due to absorption by optical (~ a few eV) photons. Above 10^{14} eV, the high-energy cosmic photon spectrum should essentially cut off because of the strong absorption by the cosmic 3°K blackbody photons, and at higher energies by the cosmic radio photons. (auth)

24945 MEASUREMENT OF SOLAR AND ATMOSPHERIC NEUTRONS. Pinkau, Klaus (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Z. Naturforsch., 21a: 2100-1(Dec. 1966). (In German).

A method is proposed for the measurement of solar and atmospheric neutrons. The method is based on the double scattering process of neutrons on protons and measurement of the two recoil protons. (J.S.R.)

24946 DEPENDENCE OF DIURNAL COSMIC-RAY VARIATION ON GEOMAGNETIC ACTIVITY AND THE SOLAR LATITUDE OF THE EARTH. Danilov, A. A.; Novikova, V. I. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 600-2(1966).

Translated from Geomagn. Aeronomiya, 6: 780-2(1966).

Previous studies are discussed on the dependence of diurnal cosmic-ray variation on geomagnetic activity and the solar latitude of the earth. Curves are plotted from data for different periods in order to correlate the diurnal variation with changes in geomagnetic activity. Results indicate that the amplitude of the first harmonic of the diurnal wave increases with increasing geomagnetic activity only when the earth is projected on the northern hemisphere of the sun. (J.H.M.)

24947 SECULAR VARIATIONS OF COSMIC-RAY INTENSITY AND THE 11-YEAR SOLAR ACTIVITY CYCLE. Charakhch'yan, A. N.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 356-61(1966).

Translated from Geomagn. Aeronomiya, 6: 486-93(1966).

Data from 1957 to 1964 on secular variations of cosmic-ray intensity in the stratosphere are analyzed. Secular intensity variations in interplanetary space are almost exclusively governed by the 11-yr solar activity. Some space and time patterns of cosmic-ray modulation in interplanetary space are found. The radius of the sphere about the sun, r, within which modulation of galactic cosmic rays occurs, depends on solar activity. The total intensity of galactic cosmic rays near the earth ($p \geq 0.5$ Bv) reached almost 90 to 95% of cosmic-ray intensity outside the modulation sphere at the end of 1964. It is concluded that in a period of minimum solar ac-

tivity there is no significant difference in the energy spectra of galactic cosmic rays near the earth and beyond the region of modulation. (auth)

24948 AN INTERESTING CASE IN THE FLUCTUATION OF COSMIC-RAY INTENSITY IN THE STRATOSPHERE ON DECEMBER 3, 1964. Charakhch'yan, A. N.; Sokolov, V. N.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 438(1966). Translated from Geomagn. Aeronomiya, 6: 586-7(1966).

Results of one of three measurements of cosmic-ray intensity at Dolgoprudnyi were found higher than normal. They fell on a curve obtained for cosmic-ray intensity at Olen'ya station (Murmansk area). This discrepancy cannot be explained on the basis of geomagnetic field decrease and magnetic cutoff rigidity. Also, it seems improbable that the deviations of data result from instrument errors. (J.H.M.)

24949 SHOWERS IN LEAD PRODUCED BY 0.1 TO 1 GeV γ QUANTA. Zaimidoroga, O. A.; Prokoshkin, Yu. D.; Tsupko-Sitnikov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 52: 1027-33(1967). (In Russian).

The characteristics of showers produced in lead by 0.1, 0.2, 0.3, 0.5, and 1 GeV γ quanta are determined on basis of the experimental data on the electron distributions of showers produced in lead by electrons. (auth)

24950 COSMIC-RAY VARIATIONS AS A FUNCTION OF THE SHORTEST DISTANCE FROM THE EARTH TO THE AXIS OF THE CORPUSCULAR STREAM. Danilov, A. A. (Inst. of Cosmophysical Investigations and Aeronomy, Novosibirsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 505-10(1966). Transiated from Geomagn. Aeronomiya, 6: 664-70(1966).

The dependence of cosmic rays on the angle $\Delta\varphi$ is examined. It is found that: (1) There is a correlation between isotropic cosmic-ray intensity variations and the angle $\Delta\varphi$ of active formations in the northern hemisphere of the sun in periods with small geomagnetic disturbances. The sign of the correlation is negative. There is no correlation with the variation of the angle $\Delta\varphi$ of active formations in the southern hemisphere of the sun. (2) Diurnal cosmic-ray variations are asymmetrically increased at stations in the Northern Hemisphere of the earth during the IGY compared with similar variations at Southern Hemisphere stations. The following conclusions are derived from the facts obtained: (1) In the stationary state the earth is connected by the lines of force of the interplanetary magnetic field only with the northern hemisphere of the sun. The lines of force are bent toward the south with respect to the solar equator. (2) The $H_{||}$ component predominates in the axial portion of a corpuscular stream and $H_{\perp}$ predominates at its periphery. (auth)

Direct Energy Conversion

24951 (NUMEC-3731-4.5-3) PRESSURE-VOLUME-TEMPERATURE RELATIONSHIPS FOR HELIUM. Garber, Harold J. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Feb. 10, 1967. Contract AT(30-1)-3731. 40p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A literature survey of readily available published helium pvT data was made and the results were applied to the formulation of a relatively simple equation of state. On the basis of simplicity and ability for wide extrapolation, the four constant Keyes type of equation was selected for representation of the data. Treatment of the data disclosed the excellent applicability of the Keyes equation, but different sets of constants are required to cover the 10 to 1,000 and 2,900 to 15,000 atmosphere ranges for which published experimental pvT data currently exist. Because the lower-pressure and ultra-high-pressure data do not "merge smoothly", it was necessary to make an arbitrary decision regarding a pvT formulation to fill in the 1,000 to 2,900 atmosphere gas region. The recommended helium equation of state (p = atmospheres, T = °K, v = cm^3/gm mole) is $p = (82.0567\ T/v-\Gamma) - [3{,}258.3/(v + 6.84)^2]$: $\Gamma = 16.418e^{-4.045/v}$ for $10 \leq v \leq 17$; $\Gamma = 11.987e^{-.491/v}$ for $17 \leq v \leq 80$; and $\Gamma = 13.732e^{-11.575/v}$ for $v \geq 80$. These formulations appear to fit the reported experimental data with a mean deviation of approximately 0.2 percent. (auth)

24952 NEW TYPE OF COMPOSITE ALL-METAL ELECTRON EMITTER FOR VALVES AND ELECTRON-OPTICAL DEVICES. Albert, M. J.; Atta, M. A.; Gabor, D. (Imperial Coll. of Science and Technology, London). Brit. J. Appl. Phys., 18: 627-33(May 1967).

Tungsten wires coated with a mixture of tungsten powder, metallic thorium and a small addition of zirconium are found to have emission densities an order of magnitude better than thoriated-tungsten emitters at the same temperatures, and currents up to 30 A cm^{-2} can be drawn. A further improvement is achieved if the tungsten powder is replaced by tungsten carbide. These cathodes can be operated at temperatures up to 1600°C, where a chemical change occurs. Replacing thorium by metallic lanthanum allows lowering of the temperatures at equal emission by 200°C. The safe limiting density is about 10 A cm^{-2} in either case. Replacing zirconium by hafnium allows emission densities of about 100 A cm^{-2} to be achieved before a chemical change occurs. The new cathodes make it possible to increase the intrinsic brightness in electron-optical devices by an order of magnitude over pure tungsten cathodes, at comparable lives. (auth)

24953 ANALYSIS OF AN EXPERIMENTAL THERMIONIC CONVERTER WITH PLANE GEOMETRY IN THE LOW PRESSURE RANGE. Karow, H.-U. (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 9: 161-8(Mar. 1967). (In German).

An experimental thermionic converter with plane geometry and variable electrode spacing was built and tested. The characteristic curves of the converter were measured in the vacuum and low-pressure range, and the radial temperature distribution on the emitter was examined theoretically and experimentally. Applying the spot cathode theory to the Cs-covered tungsten emitter, one finds theoretical characteristic curves which match rather well the measured characteristics. The efficiency of the converter is calculated and discussed. (auth)

24954 ELECTRICAL CHARACTERISTICS OF A CHANNEL WITH TERMINAL ELECTRODES WITH ALLOWANCE MADE FOR POTENTIAL DROP AT THESE ELECTRODES. Vatazhin, A. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 63-6(Nov.-Dec. 1966). (In Russian).

Spatial problems determining the electric field in a magnetohydrodynamic channel with due allowance for electrode potential drop have been formulated using the condition of low electrode layer thickness, which permits extending the relationships on the layer boundary to the electrode surface and assumes the possibility of representing the dependence of potential drop $\delta\phi^0$ at the electrodes on current density j_n^0 on the electrode in the form of the known function $\delta\phi^0 = f(j_n^0)$ determined by experiment or from the pertinent electrode layer theory. An approximate method of solving such problems has previously been proposed which reduces them to a calculation of the electric field from the known distribution of the magnetic field and of the gas-dynamic parameters. One of these problems defines the electric current in a channel with a single pair of symmetric electrodes. In the first approximation its solution is found in the form of a Keldysh-Sedov integral formula. This solution is analyzed for the case of a step relationship of $\delta\phi^0$ along the electrodes. The channel studied has height h with two symmetrical electrodes 2λ long. A medium of constant conductivity σ in magnetic field $B^0 = (0, 0, -B^0(x^0))$ moves along the channel with velocity $v^0 = (V^0(x^0), 0, 0)$. Interaction of field and medium between the electrodes generates potential difference $\phi^{0+} - \phi^{0-}$ (considered as given) and current J^0 to be determined flows along the load connecting the electrodes. (ATD)

24955 NONISOTHERMAL FLOW OF A PLASMA IN A PLANE MAGNETOHYDRODYNAMIC CHANNEL. Sanochkin, Yu. V.; Filippov, S. S. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 58-62(Nov.-Dec. 1966). (In Russian).

The laminar stationary flow of a conducting medium is calculated in a plane channel in the presence of a transverse magnetic field, under the assumption that there is no longitudinal heat flow and that all the transport coefficients depend on the temperature. Account is also taken of the viscous energy dissipation. The transverse velocity and temperature distributions are obtained for channel walls maintained at a constant temperature. It is shown that the problem can be formulated in the form of a nonlinear boundary value problem with six dimensionless parameters, which can be solved only by numerical means. The possible boundary conditions for the flow are listed and principal attention is paid to the short-circuited MHD generator and no-load MHD-generator modes. Temperature and velocity distributions are obtained for several conditions, and account is taken of the influence of the nonisothermal flow on the coefficients of surface friction and heat transfer at the wall. (ATD)

24956 LA CONVERSION DES ENERGIES. (Energy Conversion). David, Regis. Que Sais-Je, le Point des Connaissances Actuelles No. 1205. Paris, Presses Universitaires de France, 1966. 134p.

In as simple form as possible the characteristic traits of each known energy conversion process is given for the layman. The transformation of mechanical energy into electrical energy, of luminescent energy into electrical energy, direct transformation of electrical energy into light energy, transformation of chemi-

cal energy into electrical energy, transformation of thermal energy into electrical energy, transformation of matter into energy, and magnetohydrodynamic conversion are considered. (J.S.R.)

24957 SOLAR AND AEOLIAN ENERGY. Proceedings of the International Seminar Held at Sounion, Greece, September 4–15, 1961. Spanides, A. G.; Hatzikakidis, Athan D. (eds.). New York, Plenum Press, 1964. 498p. $17.50. (CONF-610903).

Numerous techniques and apparatuses useful for the exploitation of solar and aeolian energy over a wide technical and geographic area are reviewed. Principal topic areas are: conversion of solar energy to electricity, saline water conversion by means of solar stills, use of freezing unit machinery operated by solar energy, hydroponics, solar energy as a fuel substitute, and techniques for power production from aeolian energy. (J.H.M.)

24958 IMPROVEMENTS IN OR RELATING TO MAGNETOHYDRODYNAMIC ELECTRICAL GENERATORS. Gardner, Godfrey Cuthbert (to Central Electricity Generating Board). British Patent 1,068,411. May 10, 1967. Filed June 11, 1964.

A magnetohydrodynamic electric power generating system is described with means for mixing and entraining cooled molten slag particles in the gases from the generator duct. These particles are made up of condensed seed compounds and associated impurities on which the seed material in the gas condenses. Means are provided for separating the entrained slag from the gases leaving the mixing and entraining means. (M.H.R.)

24959 IMPROVEMENTS RELATING TO THERMOELECTRIC GENERATORS. Kellett, Frank; Skelt, Edward Ralph (to Associated Electrical Industries Ltd.). British Patent 1,067,869. May 3, 1967. Filed Dec. 12, 1962.

A thermoelectric generator assembly is described which includes two elements of dissimilar semiconducting materials, a metal bridge piece connecting adjacent ends of the elements, and an electrically insulating base member supporting said elements and electrically isolating the other ends of said elements from each other. The assembly also includes at least one sinuous, non-resilient, pliable portion located between one of said elements and another of these components and capable of repeated deformation permitting relative movement between said elements. (M.H.R.)

24960 THERMOELECTRIC CELL AND REACTOR. Grover, George M.; Pidd, Robert W.; Salmi, Ernest W. (to U. S. Atomic Energy Commission). U. S. Patent 3,321,646. May 23, 1967.

This patent relates to a thermionic device utilizing an ionizable gas between cathode and anode wherein the cathode contains a fissionable material or is composed of a refractory metal carbide. (AEC)

24961 ELECTRIC CURRENT GENERATOR. Garnier, Michel Robert (to Societe Nationale d'Etude et de Construction de Moteurs d'Aviation). British Patent 1,066,547. Apr. 26, 1967. Priority date June 7, 1963, France.

An installation for generating electric current employing, in combination, a gas turbine engine and a thermionic converter having at least two electrodes is described. The heat for heating the cathode of the converter is withdrawn from the circuit of the gas turbine engine upstream of the turbine. The gas turbine engine can be used to drive an alternator, in which case the combination makes it possible to have available both direct current, which is available between the cathode and the anode of the thermionic converter, and alternating current delivered by the alternator. (J.H.M.)

Fluid Physics

Refer also to abstracts 24955 and 24958.

24962 (MATT-478) VARIATIONAL PRINCIPLE FOR STATIONARY MAGNETOHYDRODYNAMIC EQUILIBRIA. Greene, John M.; Karlson, Erik T. (Princeton Univ., N. J. Plasma Physics Lab.). Oct. 1966. Contract AT(30-1)-1238. 28p. Dep. CFSTI.

A variational principle of Hamilton's type is constructed for stationary, bounded magnetohydrodynamic flows, also known as stationary equilibria. The chief object is to find how much information must be given in order to have a well-posed problem. The results indicate, but do not rigorously prove, that five suitably chosen functions of a single variable and the location of a rigid conducting boundary define a unique stationary flow. Comparison is made with other variational principles. (auth)

24963 (N-67-13098) EXPERIMENTAL PERFORMANCE OF A LOW-POWER MPD ARC THRUSTOR. Johansen, A. E.; Bowditch, D. N.; Burkhart, J. A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [1966]. 15p. (NASA-TM-X-52258; CONF-670111-2).

From American Institute of Aeronautics and Astronautics Meeting, New York.

A simple, low-power magnetoplasmadynamic (MPD) arc thrustor has been under investigation. It is light-weight, requires a minimum of power-conditioning equipment, and operates on low voltages which are compatible with a solar cell array. Thrustor development has concentrated on an efficient thrustor with a sturdy, long-lived cathode and lightweight radiation-cooled electromagnets in combination with a permanent magnet. Continuous operation of over 420 hours has been achieved. Thrustor performance has been improved by introducing most of the propellant flow into the anode through a separate feed system and by using xenon gas as the propellant. Results of a parametric survey of various thrustor configurations are presented. The thrustor exhibiting the best performance operated at an average thrust/power ratio of 7 millipounds per kilowatt over a range of thrust values from 0.5 to 1.7 millipounds for specific impulses up to 1300 seconds. (auth)

24964 DRAG ON BODIES MOVING IN A RAREFIED PLASMA. Moskalenko, A. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 381-92(1966).

Translated from Geomagn. Aeronomiya, 6: 518-32(1966).

The drag on bodies moving in a rarefied plasma is analyzed. It is due to direct collisions of particles with the surface of the moving body and to their interaction with the electric field in the vicinity of the body. The drag force is determined for large and small bodies the dimensions of which are respectively large or small compared with the Debye radius of the undisturbed plasma. (auth)

24965 MAGNETOHYDRODYNAMIC FLOW IN CHANNELS OF VARIABLE CROSS SECTION WITH STRONG TRANSVERSE MAGNETIC FIELDS. Hunt, J. C. R. (Central Electricity Generating Board, London); Leibovich, S. J. Fluid Mech., 28: 241-60(1967).

An analysis is made of the steady incompressible, two-dimensional flow of conducting fluids through ducts of arbitrarily varying cross section under the action of a strong, uniform, transverse, magnetic field. The flow is examined in three separate regions: (1) the 'core' region in which the pressure gradient is balanced by electromagnetic forces; (2) Hartmann boundary layers, where electromagnetic forces are balanced by viscous forces; (3) thin layers parallel to the magnetic field, in which electromagnetic forces, inertial forces, and the pressure gradient balance each other. These layers occur where the slope of the duct wall changes abruptly. By expanding the solution as a series in descending powers of N the velocity distribution for regions (1) and (2), for finite values of N attainable in the laboratory, is calculated. (auth)

24966 DEVELOPMENTAL STAGE OF MAGNETOHYDRODYNAMIC GENERATORS. Euler, Karl Joachim (Varta AG, Frankfurt am Main); Niekisch, Ernst August. VDI (Ver. Deut. Ing.) Z., 109: 433-8(Apr. 1967). (In German).

Magnetohydrodynamic generators serve for directly obtaining electric power, their technical development still being in its initial stages. Said magnetohydrodynamic generators operate by means of ionized combustion gases or noble-gas plasmas; by way of exception they even operate using molten metals. The tests run so far have shown a success with surge generator sets only that produced effective capacities of a multiple of 10 MW during 1-sec pulse durations. So far no MHD generator has been designed that is suitable to answer continuous operative purposes. The stage of development of all MHD types does not yet allow a reliable forecast to be made as to whether they are technically and economically feasible. (auth)

24967 PROPAGATION OF MAGNETOSONIC WAVES IN LAMINAR MEDIA. Kosachevskii, L. Ya. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 73-6(Nov.-Dec. 1966). (In Russian).

Magnetosonic wave reflection from the plane surface of a conducting liquid or gas distributed in a homogeneous field was studied. The reflection and layer penetrability coefficients were found for the maximum weak or maximum strong magnetic fields. (R.V.J.)

24968 TEMPERATURE FLUCTUATIONS OF TURBULENT MAGNETOFLUID DYNAMIC FLOW. Blum, E. Ya. (Inst. of Engineering Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 6, 45-50(1966). (In Russian).

Temperature fluctuation measurements of the turbulent magnetofluid-dynamic flow in electrolytes was carried out. The intensity of the low-frequency fluctuations was found to be reduced by the imposed transverse magnetic field. (auth)

24969 GENERATION OF A MAGNETIC FIELD NEAR THE BOUNDARY OF A CONDUCTOR. Kropachev, E. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Leningrad). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 406-12(1966).

Translated from Geomagn. Aeronomiya, 6: 548-55(1966).

In the vicinity of the boundary of a conducting medium there revolves a sphere of the same conductivity. The angular velocity vector of the sphere is perpendicular to the normal to the boundary. It is shown that generation of a stationary electromagnetic field is possible at a definite speed of rotation. This is of interest to the dynamo theory of the origin of cosmic magnetic fields. (auth)

24970 TWO-DIMENSIONAL FLOW OF AN IDEAL CONDUCTING GAS IN THE VICINITY OF THE ZERO LINE OF A MAGNETIC FIELD. Imshennik, V. S.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 52: 990-1002(1967). (In Russian).

The motion of a conducting gas in the vicinity of the zero line of a magnetic field is considered on the basis of the magnetic-hydrodynamic equations. A class of exact solutions of the nonstationary two-dimensional problem is obtained. In these solutions the velocity linearly depends on the coordinates. The time dependence is such that during a finite period of time a singularity is reached which corresponds to infinite growth of the velocity, magnetic field strength, gas density, and electric current density. In this case the current density grows at a faster rate than the gas concentration, in accordance with the realization of the conditions of dynamic dissipation of the magnetic field. For the immediate vicinity of the zero line the solution obtained may be considered as the senior term in the general solution of the rigorous boundary problem. (auth)

24971 ON FRICTION OF MHD FLOW PASSING CERTAIN SPHERE. Branover, G. G.; Slyusarev, N. M.; Tsinober, A. B. Magnit. Gidrodin., No. 3, 149-50(1966). (In Russian).

A sphere 2.75 mm in diameter was secured by a 0.3 mm needle to a strain gage, and was placed in a turbulent flow of mercury in a rectangular channel having a cross section 2 × 5 cm. The magnetic induction in the gap went up to B = 0.8 weber/m^2. The resistance was correlated with the rate of flow at different values of the magnetic induction. The resistance tends to become a linear function of flow rate on increasing the magnetic field. This behavior is similar to Skokes' streamline flow of a sphere. The results fit the following empirical relation: $C_x/C_0 = 1 + N^{0.5}$. Here C_x is the resistance coefficient in the presence of the magnetic field; C_0 is the resistance coefficient at the same Reynolds number outside the magnetic field, and N is the Stewart number. (TTT)

24972 ON THEORY OF MHD FLOWS OF VISCOUS PLASTIC FLUIDS. Martinson, L. K.; Pavlov, K. B. Magnit. Gidrodin., No. 3, 152(1966). (In Russian).

The flow of a visco-plastic medium can be separated into a number of independent regions: a zone of viscous flow and a zone of quasisolid flow. The zone boundaries are determined by the shear stress on the visco-plastic medium. The flow in the viscous region is described by a differential equation similar to that describing the motion of a viscous, Newtonian liquid. Integral conditions must be used in considering the zone of quasisolid motion, or unreliable results will be obtained. The size of the quasisolid zone z_0 is given by the following relation: $(P + \sigma E_0 B_0)\, z_0/\tau_0 = \text{ch}\, M\,(1 - z_0/L)$. (TTT)

24973 ON VARIOUS DEFINITIONS OF MAGNETIC REYNOLDS' NUMBER. Voldek, A. I. Magnit. Gidrodin., No. 3, 152-4 (1966). (In Russian).

The magnetic Reynolds number is given as follows: $R_m = \mu\sigma vl$. Here v is the relative rate of movement of the magnetic field and the conducting medium. For an induction MHD machine with a traveling magnetic field it is necessary to set $v = v_c - v_m$, where v_c is the rate of movement of the field or the synchronous velocity, and v_m is the rate of movement of the medium. Slippage of the conducting medium is given as: $s = (v_c - v_m)/v_c$ or $v_m = (1-s)v_c$. Hence we can also write: $v = sv_c$ and $v = sv_m/(1-s)$. These forms are all equivalent for an induction MHD-machine. Contradictions occur on comparing an induction MHD-machine with a constant-current, conducting, MHD-machine. Probably there will always be differences in comparing these two types of machines, and special formulas will have to be used to relate the R_m values. (TTT)

Geophysics

Refer also to abstracts 24255–24258, 24882, 24890, 24900, 24902, 24923, 24984, and 24987.

24974 (LA-DC-8497) SATELLITE OBSERVATIONS OF THE GENERAL CHARACTERISTICS AND FILAMENTARY STRUCTURE OF THE SOLAR WIND. Strong, I. B.; Asbridge, J. R.; Bame, S. J.; Hundhausen, A. (Los Alamos Scientific Lab., N. Mex.). Feb. 1, 1967. Contract W-7405-eng-36. 27p. (CONF-670116-1). Dep. CFSTI.

Solar wind observations made by electrostatic analyzers on four separate Vela satellites, the Vela 2 satellites launched in July 1964 and the Vela 3 satellites in July 1965, are reported. Information is included on directional properties of the solar wind, velocity and temperature, and filamentary structure in the wind. (J.H.M.)

24975 (N-67-11369) THERMAL PLASMA MEASUREMENTS WITHIN THE MAGNETOSPHERE. Serbu, G. P.; Maier, E. J. R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1966. 14p. (NASA-TM-X-55591; X-615-66-328). CFSTI $3.00 cy, $0.65 mn.

It was observed that both the ion and electron components of the plasma present within the magnetosphere exhibit, at most times, a Maxwell–Boltzmann energy distribution. The temperature of the electron gas increases by a factor of about 10 from above the ionosphere to an altitude of 2.5×10^4km (5 R_E geocentric). Over this same region, the density decreases to a minimum of about 50 cm^{-3}. Less pronounced variations of temperature and density with radial distance are noted beyond 5R_E. The simultaneous observation of ion and electron density profiles provides verification of charge neutrality over vertical dimensions of the order of kilometers. (STAR)

24976 (N-67-11371) PROTON EVENTS IN THE MAGNETOSPHERE ASSOCIATED WITH MAGNETIC BAYS. Konradi, Andrei (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1966. 28p. (NASA-TM-X-55594; X-611-66-332). CFSTI $3.00 cy, $0.65 mn.

A series of 13 sudden increases in the proton flux was observed at L > 8 on the subsolar side of the magnetosphere during August, September, and October 1961. These increases are strongly correlated with the appearance of negative magnetic bays in the auroral zone. The increases exhibit proton intensities of J(>100 keV) < 10^6p/cm^2 sec ster. The particle intensity rise time is of the order of 10 minutes. The protons have strongly peaked energy distributions and the peak energy decreases with time during a period of about 1 hour from about 300 keV to 100 keV. The events are interpreted as protons drifting in the earth's magnetosphere after being injected into it on the night side. (auth)

24977 (N-67-11378) OBSERVATIONS OF THE SOLAR WIND INTERACTION WITH THE GEOMAGNETIC FIELD: CONDITIONS QUIET. Ness, Norman F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug. 1966. 58p. (NASA-TM-X-55605; X-612-66-381). CFSTI $3.00 cy, $0.65 mn.

Satellite measurements of the outer geomagnetic field have revealed the distortion and containment of the geomagnetic field and formation of an external magnetic tail as a result of the flux of the solar wind. In addition there appears to be a permanent detached bow shock wave associated with the super-Alfvénic interaction of the solar plasma with the geomagnetic field. Both the shock wave and magnetopause are frequently in motion. Details of the earth's neutral sheet indicate frequent fluctuation of its position in the magnetic tail in the absence of any significant magnetic or solar activity. There remain, however, certain major problems in establishing definitive quantitative models of the physical phenomena which have been observed. It can be anticipated that within 10 years after the discovery of the radiation belts, i.e., 1968, that a great wealth of additional experimental data will be available from the recent sophisticated and high-data-rate satellites such as EGO's and Pioneers, providing definitive as well as simultaneous determinations of separate particle, plasma, and field phenomena. (auth)

24978 (N-67-12234) EFFECT OF THE RING CURRENT ON THE DISTRIBUTION OF UNBOUND PARTICLES IN THE MAGNETOSPHERE. McDonald, Perry F. (Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.). June 1966. Contract NAS8-20166. 53p. (NASA-CR-78971; R-204). CFSTI.

The effect of the ring current due to the drift of trapped particles in the radiation belts on the distribution of untrapped particles in the magnetosphere is analyzed using a current sheet approximation to the ring current. The shape assumed for the current sheet is the figure obtained by rotating a dipole field line about the axis. The vector potential of a dipole plus a distributed ring current is derived and applied in Stomer's theorem to determine allowed and forbidden regions of particle motion. Liouville's theorem is used to obtain the ratio of unbound particle flux at points inside the model magnetosphere to an isotropic uniform flux at infinity. (STAR)

24979 (N-67-13726) [ANALYSIS OF SATELLITE DATA FOR STUDIES RELATED TO IONOSPHERIC PLASMA RESEARCH].

Semiannual Status Report, April 1–September 30, 1966. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Sept. 30, 1966. 6p. (NASA-CR-80741). CFSTI.

Some specific investigations being conducted under a research program concerned with the general area of the ionospheric plasma are briefly discussed. These deal with the use of cylindrical Langmuir probes onboard the Explorer XVII and XXII satellites to study the ionospheric plasma, and the interaction of spacecraft with the ionospheric plasma. (STAR)

24980 (N-67-15320) ROCKET OBSERVATIONS OF LOW ENERGY AURORAL ELECTRONS. Evans, David S. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug. 1966. 42p. (NASA-TM-X-55617; X-611-66-376). CFSTI $3.00 cy, $0.65 mn.

Solar activity and subsequent auroral display, solar wind to provide energy, and the energization of auroral particles are some topics briefly reviewed. Details are given on instrumentation for rocket payload soundings to detect primary auroral electrons, and results of measurements of the primary electron influx associated with the aurora. The most significant result of the auroral electron measurements performed on two flights described is the observation on two separate occasions of differential energy spectrums which are suggestive of electrostatic acceleration mechanisms having been responsible for the energization of auroral electrons. It is further seen that the process responsible for the electron flux exhibited great stability in time, and the homogeneous nature of the influx over 50-km distance. These points serve to eliminate more dynamic mechanisms as the source of electron energization and precipitation. (STAR)

24981 (RM-5249-PR) LF AND VLF REFLECTION LOSS IN THE LOWER IONOSPHERE: A THEOREM ON ABSORPTION AND ITS APPLICATION. Booker, H. G.; Crain, C. M. (RAND Corp., Santa Monica, Calif.). Mar. 1967. 34p.

A theorem is presented for calculating low frequency and very low frequency reflection loss in the lower ionosphere. The theorem demonstrates that the phase-integral method for calculating the attenuation of radio waves reflected from the ionosphere is accurate in the lf and vlf bands. On the basis of the theorem, two simple methods for estimating lf and vlf reflection loss are devised, and the procedures for application of the methods are detailed. For evaluations of lf and vlf transmission loss in nuclear burst environments involving highly oblique reflections in the lower D region, the methods presented can be applied with adequate accuracy for transmission frequencies at least as low as 10 kHz. (J.H.M.)

24982 (N-67-13235) OBSERVATIONS OF EXTREMELY LOW FREQUENCY EMISSION AT TWO CONJUGATE POINTS. Kleymenova, N. G.; Troitskaya, V. A.; Zhandren, R.; Ponso, K.; Vineron, Zh. Translated from Dokl. Akad. Nauk, SSSR, 170: 835-6(1966). 5p. (NASA-CR-80578). CFSTI.

Conclusions resulting from the combined Soviet–French investigations of extremely low frequency (elf) emissions at two magnetically conjugate points are reported. The principal conclusion is that choruses, observed simultaneously at conjugate stations, are forerunners of impending negative ionospheric storms. During magnetoquiet days, no favorable conditions exist for the generation of elf in the earth's exosphere when the outer magnetosphere boundary is situated at $10R_E$. (auth)

24983 HIGH LUMINOSITY SPECTROGRAPH FOR RECORDING THE FAR ULTRAVIOLET SPECTRA OF AURORA. Monfils, A.; Vreux, J.-M. (Institut d'Astrophysique, Cointe-Sclessin, Belg.). J. Sci. Instrum., 44: 357-9(May 1967).

A high luminosity spectrograph using an inverse Wadsworth mounting was constructed for recording auroral spectra in the far ultraviolet. Two versions were developed, the first (with a demagnification of two) appears to be suitable for photoelectric recording, while the second (with a demagnification of four) seems better for photographic recording. In both cases the main aberrations were eliminated. (auth)

24984 RAPID VARIATIONS OF THE ELECTROMAGNETIC FIELD AS AN INDICATION OF THE STATE OF THE RADIATION BELTS AND THE GEOMAGNETOSPHERE. Troitskaya, V. A.; Bol'shakova, O. V.; Matveeva, E. T. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 393-8(1966).

Translated from Geomagn. Aeronomiya, 6: 533-40(1966).

The results are reported of a comparison between satellite data on the variations of the position of the magnetosphere boundary and of the outer radiation belt with the excitation patterns of stable pulsations of the Pc type, as well as the results of a study of the relationship of intensity variations in the outer radiation belt to the excitation of irregular short-period pulsations (Pi 1) and pulsations of the "pearl" type (Pc 1). (auth)

24985 SYNCHROTRON RADIATION IN A DIPOLE MAGNETIC FIELD. Molodenskii, M. M.; Korchak, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 376-80 (1966).

Translated from Geomagn. Aeronomiya, 6: 512-17(1966).

The characteristics of synchrotron radiation of relativistic electrons in a dipole magnetic field with the dipole arbitrarily oriented with respect to the line of sight are computed for a power-law energy spectrum and an angular distribution proportional to $\sin^k \alpha$. (auth)

24986 NEUTRAL (NULL) POINTS OF MAGNETIC FIELDS. Zhugzhda, Yu. D. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 371-5(1966).

Translated from Geomagn. Aeronomiya, 6: 506-11(1966).

The geometry of a magnetic field in the small neighborhood of neutral points is investigated. A complete classification of the neutral points of a free field is described in detail. It is shown that the neutral points of a force-free field in a small neighborhood reduces to the neutral points of a free field with an accuracy to higher-order terms. The simplest neutral points of a static field are analyzed. (auth)

24987 SHAPE OF A CAVITY WITH A PLANE MAGNETIC DIPOLE UNDER ISOTROPIC EXTERNAL PRESSURE. Samokhin, M. V. (Radio Engineering Inst., Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 433-5(1966).

Translated from Geomagn. Aeronomiya, 6: 582-3(1966).

A method of solving a two-dimensional problem with isotropic external pressure is described. The problem is used to determine the shape of the magnetosphere boundary on the condition that the solar plasma pressure is isotropic. (J.H.M.)

24988 ONCE MORE ON THE POSSIBILITY OF DETERMINING LOCAL ELECTRON CONCENTRATION BY THE DISPERSION METHOD USING ARTIFICIAL EARTH SATELLITES AND NEW IONIZATION MAXIMA IN THE IONOSPHERE. Gringauz, K. I.; Kravtsov, Yu. A.; Rudakov, V. A.; Rytov, S. M. (Radio Engineering Inst., Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 422-31(1966).

Translated from Geomagn. Aeronomiya, 6: 568-79(1966).

The possibility of determining local concentration N_e by the dispersion method using artificial earth satellites is discussed. It is shown that determination of N_e by this method yields unreliable results because of the presence of horizontal ionization gradients in the ionosphere and because the ionosphere is not stationary. The conclusion is reached that the results described in several papers by Al'pert and others are unreliable. The unreliability of these results is also due to the incorrect method used to process the experimental data. (auth)

24989 INTERACTION OF ENERGETIC CHARGED PARTICLES WITH HYDRODYNAMIC WAVES. Shabanskii, V. P. (Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 345-50(1966).

Translated from Geomagn. Aeronomiya, 6: 472-8(1966).

The transit of an energetic particle through the front of a hydrodynamic shock wave is examined on the assumption that particle velocity substantially exceeds the velocity of the wave and that the Larmor radius exceeds the width of the wave front. It is shown that the magnetic moment of the particle remains constant. The displacement of the instantaneous center of rotation of the particle on passage through the front is computed. The possible displacement of radiation-belt particles (diffusion rate) by a hydromagnetic wave propagating along the magnetosphere is estimated. (auth)

24990 BEHAVIOR OF RADIATION-BELT PARTICLES DURING MAGNETIC STORMS. Shabanskii, V. P. (Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 351-5 (1966).

Translated from Geomagn. Aeronomiya, 6: 479-85(1966).

The radial displacements of radiation-belt particles, caused by global magnetic storms, are examined. The source of the disturbance is the current at the magnetosphere boundary, produced by the solar wind, and the ring current in the magnetosphere. Only the fundamental harmonic (homogeneous component) of the disturbance field from the first source is taken into account. This leads, for most of the belt particles, to reversible displacements. Particles with mirror points at a small height above the earth's surface may descend into the dense layers of the atmosphere during their radial passage through the shells and be dumped. Specific examples of the storms of February 12 and 20, 1964, are examined. (auth)

24991 SOME RESULTS OF RADAR OBSERVATIONS OF AURORAS AT YAKUTSK DURING THE IQSY. Makrygin, A. M.; Ponomarev, E. A. (Inst. of Cosmophysical Research and Aero-

nomy, Yakutsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 605-7(1966).

Translated from Geomagn. Aeronomiya, 6: 786-7(1966).

Data obtained from radar observations in the period from January 1, 1964, to April 30, 1965, were analyzed. The results of analysis of the space distribution of the radar reflections are presented in azimuth–distance coordinates for 4 seasons (spring, summer, and autumn of 1964 and spring of 1965). (J.H.M.)

24992 DIMENSIONS OF INHOMOGENEITIES OF THE GREEN LINE OF ATOMIC OXYGEN IN AIRGLOW. Nasyrov, G. A. (Physical-Technical Inst., Ashkhabad, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 608-9(1966).

Translated from Geomagn. Aeronomiya, 6: 788-9(1966).

Airglow observations according to the IQSY program are used to determine the dimensions of the spatial inhomogeneities of the green line of atomic oxygen. The results of an analysis of observations made in January–December 1964 are reported. A total of 3240 spatial inhomogeneities was observed in this period on 59 nights. A curve is presented that shows the probability of appearance of spots, and a histogram of the size distribution of spots is included. (J.H.M.)

24993 DOPPLER FREQUENCY SHIFT OF AN EMITTER MOVING IN THE IONOSPHERE. Pavlenko, Yu. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 609-11(1966).

Translated from Geomagn. Aeronomiya, 6: 790-2(1966).

Previous computations have been made of the Doppler frequency shift for a three-dimensionally inhomogeneous ionosphere in the case when the refraction coefficient along the wave trajectory differs little from unity. The formulas obtained relate the difference in the Doppler frequencies of radio waves emitted coherently from a satellite with the local electron concentration in the vicinity of the source and with the angles of refraction that depend on the integral properties of the ionosphere. An analysis is made of a formula that was computed for the Doppler frequency shift in a coordinate system where the rectangular coordinates have one axis directed from the observation point to the source. (J.H.M.)

24994 VARIATION OF THE E_s PARAMETERS IN THE SOLAR CYCLE. Chavdarov, S. S.; Chernysheva, S. P. (Rostov State Univ., Rostov-on-Don, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 613-14(1966).

Translated from Geomagn. Aeronomiya, 6: 793-4(1966).

It was previously shown by Chavdarov, Chernysheva, and Shatkhin that the general probability of E_s appearance in Rostov-on-the-Don is not associated with solar activity, although its diurnal and seasonal patterns are clearly controlled by the sun. But the probability of appearance of E_s with a given duration of continuous reflections of no less than 2 hours has a clear inverse dependence on the phase of the solar cycle, increasing in years of minimum solar activity. To determine the generality of this relationship, an attempt is made to analyze E_s data from other stations. (J.H.M.)

24995 TEMPORAL DISTRIBUTION OF TYPE Pc1 PULSATIONS ACCORDING TO DATA FROM LOVOZERO. Loginov, G. A. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 618-21(1966).

Translated from Geomagn. Aeronomiya, 6: 799-802(1966).

Results are presented of a study of steady pearl-type pulsations lasting from tens of minutes to several hours, and having a regular sine shape and a characteristic beat regime. Information is included on the following: (1) diurnal pattern of the frequency of appearance of the pearls, (2) seasonal variations, and (3) the relationship between pearls and magnetic activity and other geophysical phenomena. (J.H.M.)

24996 AUTOMATIC MULTICHANNEL SYSTEM FOR RECORDING AND PROCESSING EXPERIMENTAL INFORMATION ON A DIGITAL COMPUTER FOR THE STUDY OF THE INHOMOGENEOUS STRUCTURE OF THE IONOSPHERE. Afraymovich, E. L. (Ionospheric Section, Academy of Sciences, Alma-Ata, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 588-92 (1966).

Translated from Geomagn. Aeronomiya, 6: 767-72(1966).

An automatic multichannel system for recording and processing data on the inhomogeneous structure of the ionosphere is described. The system includes recording equipment, a magnetic tape memory, digital computer input equipment, and computer programs for the insertion and processing of experimental data. (auth)

24997 CONTINUOUS RECORDING OF THE MINIMUM VIRTUAL HEIGHTS OF IONOSPHERIC LAYERS. Vasil'ev, K. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 593-6(1966).

Translated from Geomagn. Aeronomiya, 6: 773-6(1966).

The continuous recording of the minimum virtual heights of ionospheric layers on a type AIS ionosonde is described. (auth)

24998 ANGULAR SPECTRUM OF WAVES SCATTERED BY THE IONOSPHERE. Kazimirovskii, E. S.; Kokourov, V. D.; Chernobrovkina, N. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Novosibirsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 449(1966).

Translated from Geomagn. Aeronomiya, 6: 599(1966).

Using the results of vertical radio soundings of the ionosphere from the ground, made at Erkutsk in 1962–1964, an analysis is made of the angular scatter of a beam of reflected radio waves. The distribution of experimental values of the width of the angular spectrum of scattered waves is shown. (J.H.M.)

24999 POSSIBLE INTERPRETATION OF THE FREQUENCY DEPENDENCE OF ANOMALOUS COSMIC NOISE ABSORPTION. Belikovich, V. V.; Benediktov, E. A.; Tolmacheva, A. V. (Gorski State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 450-1(1966).

Translated from Geomagn. Aeronomiya, 6: 600-1(1966).

The results of measurements of anomalous cosmic-noise absorption in the ionosphere at several fixed frequencies were reported by Benediktov, Korobkov, and Tolmacheva. A method for interpreting their results is discussed. It is concluded that the inhomogeneous structure of the region of anomalous ionization can significantly distort the information obtained radioastronomically on the heights where the maximum absorption of radio waves passing through the ionosphere occurs. Also, it is obvious that it is necessary to allow for ionization inhomogeneities when determining the other parameters of the layer of anomalous ionization. (J.H.M.)

25000 ZONE OF ANOMALOUS ABSORPTION DURING VARIOUS PHASES OF THE SOLAR ACTIVITY CYCLE. Gorbushina, G. N.; Zhulina, E. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 453-5(1966).

Translated from Geomagn. Aeronomiya, 6: 604-5(1966).

The anomalous absorption of radio waves is examined on the basis of ionospheric observations made during 1962, which was a year of relatively low solar activity. A plot is shown of the frequency of anomalous absorption as a function of the corrected geomagnetic latitude of the observation points. Also, the geographic position of the zone of anomalous absorption for 1962 is shown. (J.H.M.)

25001 DIFFUSIVE SPREADING OF INHOMOGENEITIES IN A PLASMA IN THE PRESENCE OF DRIFT. Fiala, V. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 447-8(1966).

Translated from Geomagn. Aeronomiya, 6: 597-8(1966).

The influence of drift on the diffusive spreading of inhomogeneities in a magnetic field is investigated. Linearized continuity and motion equations are analyzed for electrons and ions. (J.H.M.)

25002 TRANSPORT COEFFICIENTS OF TRAPPED PARTICLES IN THE GEOMAGNETIC FIELD. Tverskoi, B. A. (Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 435-7(1966).

Translated from Geomagn. Aeronomiya, 6: 584-5(1966).

In previous theoretical investigations of radiation belts, calculations have been made to describe the transport of particles across drifting shells under the effect of geomagnetic disturbances. Primarily, the possible effects of sudden impulses is analyzed, since these are the only geomagnetic disturbances capable of producing transport, for which there is some amount of information. Some previous computations used for describing the transport are discussed. (J.H.M.)

25003 DISTURBANCE IN THE F2 REGION OF THE IONOSPHERE AT MIDDLE LATITUDES. Khocholava, G. M.; Gachechiladze, R. G. (Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 439-40(1966).

Translated from Geomagn. Aeronomiya, 6: 588-9(1966).

Previous analysis of disturbances in the F2 layer has led to the conclusion that two types of disturbances are chiefly observed in the ionosphere at middle latitudes: negative and positive. An attempt is made to clarify the character of ionospheric disturbances at middle latitudes. Vertical soundings of the ionosphere at six stations, located in a latitude interval of 02 to 65°N, during the IGY are used for analysis. It is concluded that positive disturbances are observed only at low latitudes and also in winter at geomagnetic latitudes higher than 47°. (J.H.M.)

25004 STABILITY OF REFLECTIONS FROM THE SPORADIC E LAYER AND RADIO WAVE ABSORPTION DURING THE SOLAR CYCLE. Svechnikov, A. M.; Chavdarov, S. S.; Chernysheva, S. P.

(Rostov-on-the-Don State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 440-3(1966).

Translated from Geomagn. Aeronomiya, 6: 590-2(1966).

Data on radio-wave absorption in the ionosphere are analyzed and data on the stability of reflections and on absorption during diurnal, seasonal, and long-period variations are compared. Also, data are analyzed to determine the influence of the zenith distance of the sun on absorption and on reflection stability. (J.H.M.)

25005 DEPENDENCE OF THE E_s LAYER ON SOLAR ACTIVITY. Kerblay, T. S.; Korochkina, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 443-6(1966).

Translated from Geomagn. Aeronomiya, 6: 593-6(1966).

Based on data from several stations located in various latitudinal belts, an examination is made of cyclic variations of E_s characteristics in the period from 1957 to 1964. The analysis was performed for each season separately for daytime and night conditions. The data indicate that the various E_s characteristics depend differently on solar activity. The most representative E_s characteristics, suitable for the study of the cyclic dependence of E_s, are the frequency distributions of f_0E_s. (J.H.M.)

25006 ATMOSPHERIC DENSITY MEASURED BY THE ATTENUATION OF THE SOLAR X-RAYS MONITORED ON THE NRL 1965-16-D SATELLITE. Landini, M.; Russo, D.; Tagliaferri, G. L. (Osservatorio Astrofisico di Arcetri, Florence). Icarus, 6: 236-41(Mar. 1967).

The atmospheric number density was calculated by measuring the attenuation of solar x rays, which occurs when the satellite passes into or out of the shadow of the Earth. The density was calculated for 7 days between April 18 and July 8, 1965. (auth)

25007 INTERACTION OF THE MOON WITH THE EARTH'S MAGNETOSPHERE. Schneider, Otto (Instituto Antartico Argentino, Buenos Aires). Space Sci. Rev., 6: 655-704(Mar. 1967).

The general characteristics and dimensions of the earth's magnetosphere, turbulent transition region, and shock wave are reviewed and examined with regard to their possible active or passive interaction with the moon. The moon may, in turn, have a wake either detectable by space experiments outside the terrestrial shock wave or capable of interacting with the earth's shock wave, wake, or magnetospheric tail. The length and detectability of such a lunar wake depend, among other factors, on the selenomagnetic field and flow characteristics of the solar wind. Direct experimental information on a lunar wake is scanty, being, in fact, limited to one supposed case recorded by the IMP-1 satellite. Some evidence has been claimed, on the other hand, for statistical relationships between geomagnetic disturbance observed at the surface and the age of the moon. These results, however, are partly conflicting with each other as regards the phase of the supposed monthly variations, and partly are lacking statistical significance or merely grazing the significance level. The proximity of the lunar period with the length of the solar rotation, as well as a yearly and half-yearly modulation of the quasi-persistent 27-day fluctuations of geomagnetic disturbance contribute to encumber the question, rendering it very difficult, with the records presently available, to free the supposed lunar effects from solar interference. It seems, therefore, recommendable to postpone a judgment on the reality of such effects. (auth)

25008 STUDY OF SOFT ELECTRONS AND IONS BY MEANS OF TRAPS ON THE COSMOS 5 SATELLITE. Dzhordzhio, N. V. (Inst. of Atmospheric Physics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 339-43(1966).

Translated from Geomagn. Aeronomiya, 6: 424-9(1966).

The results are reported of a study of heavy positive ions and soft electrons using traps installed on Cosmos 5. The design of the traps is described. The concentration of positive ions is given for heights of 200 to 300 km. Fluxes of soft electrons with an energy $3 < E < 15$ keV range from $1\text{-}3 \times 10^7$ cm^{-2} sec^{-1} for an isotropic flux on the dark side of the orbit at heights of 200 to 1200 km. (auth)

25009 INFLUENCE OF THE SOLAR WIND ON THE C LAYER OF THE EARTH'S IONOSPHERE. Krasnushkin, P. E. (Steklov Mathematical Inst., Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 452-3(1966).

Translated from Geomagn. Aeronomiya, 6: 602-3(1966).

An explanation is given of the relation of solar activity variations to the average annual intensity of the remote daytime field of extra-long radio waves propagating around the earth. Previous studies show that the propagation of terrestrial extra-long waves during the daytime is controlled by the C layer of the ionosphere. The tail of this layer, which extends to heights of 40 to 50 km, plays the role of an absorbing lining in the earth–lower ionosphere waveguide in which extra-long waves propagate to great distances. The analysis indicates that the phenomena of the modulation of extra-long waves by the solar wind can be partly masked by effects taking place during solar flares. (J.H.M.)

25010 THE "BERLIN" WARMING. Belrose, John S. (Radio and Space Research Station, Slough, Eng.). Nature, 214: 660-4 (May 13, 1967).

The stratospheric warming over Central Europe in February 1952 was accompanied by changes in the electron density of the mesosphere. Such phenomena seem to arise from changes in the atmospheric circulation which affect mesospheric pressure, temperature and composition. (auth)

25011 ROCKET ELECTRON DENSITY PERTURBATIONS IN THE IONOSPHERE. Beynon, W. J. G. (Univ. Coll. of Wales, Aberystwyth). Nature, 214: 690-2(May 13, 1967).

Reference is made to experiments on radio propagation being flown in the British Skylark rocket. In the recent flight an interesting set of multiple echoes was observed during descent over the height range 150 to 109 km. Measurements of the ranges of these echoes indicated a progressive increase by constant amounts. The constant incremental increase in the ranges of the echoes at any given rocket height and the rate at which the increments increase as the rocket descends suggest that the echoes could arise in one of two ways: (a) the echoes could be multiple reflections of some sort between the level of the rocket and the main reflecting F region; or (b) the echoes could represent independent reflections from a series of equispaced perturbations in the ionosphere. Evidence for perturbations produced in the ionosphere by satellites and rockets has been reported from several sources. Consideration of the experimental conditions as between the present observations and those of other workers indicates that it would be difficult to account for the echoes in terms of (a) above. If, however, the moving rocket produced perturbations in the background electron density at regular intervals (such as might arise from an associated wave motion) the possibility (b) may explain the observations. Regularly spaced perturbations in electron density in the neighborhood of the normal reflection level could provide a series of temporary reflection centers, and the echoes would then arise as individual reflections from such centers. (UK)

25012 TEMPERATURE COUPLING OF IONS IN THE IONOSPHERE. Banks, Peter M. (Institut d'Aeronomie Spatiale de Belgique, Brussels). Planet. Space Sci., 15: 77-93(Jan. 1967).

An investigation was made of the extent to which O^+, He^+, and H^+ ions can be considered as having a common temperature in the ionosphere. By assuming that each ion gas has its own Maxwellian velocity distribution, energy balance equations including the effects of heating by the electron gas, cooling by the neutral atmosphere, and energy coupling between the ion species were obtained. Solutions to the energy equations for three models of the neutral atmosphere indicate that the H^+ and He^+ ion temperatures are higher than the O^+ temperature in the regions between 250 and 650 km. A peak temperature difference greater than 200° occurs for H^+ and O^+ ions, while values which may reach 100° are noted for the $He^+ - O^+$ separation. An explanation of the temperature inequality is made in terms of the atmospheric and ionospheric conditions, showing that the altitude extent of ion temperature separation increases for rising thermospheric and electron temperatures and decreases for progressively larger electron densities. (auth)

25013 ELECTRON AND ION TEMPERATURE VARIATIONS IN TEMPERATURE ZONE SPORADIC-E LAYERS. Gleeson, L. J.; Axford, W. I. (Cornell Univ., Ithaca, N. Y.). Planet. Space Sci., 15: 123-36(Jan. 1967).

The energy equations for ions and electrons moving in a neutral gas have been used to predict the changes in electron (T_e) and ion (T_i) temperatures in ionospheric sporadic-E (E_s) layers formed according to the wind shear theory. It is predicted that within such an E_s layer T_e has a minimum and that T_e is greatest in regions of low electron density; overall variations in T_e of about 70°K are expected near an altitude of 115 km, these variations increasing with altitude and electron density. Vertical electric fields produced by gradients in electron density might produce additional, observable, double hump variations in T_e at night, at altitudes of about 130 km. (auth)

25014 STRUCTURE AND FORMATION OF THE LOWER IONOSPHERE. Thrane, E. V. (Forsvarets Forskningsinstitutt, Kjeller, Norway). Elektrotek. Tidsskr., 80: [No. 8], 141-50.

A discussion of the formation and structure of the ionospheric D region is presented. The first part deals with results of rocket and sophisticated ground-based experiments to determine the height variation of the concentration of the free electrons and their collision frequency. Distinction is made between the un-

disturbed D region as observed at low and intermediate latitudes, and that observed in polar regions. The second part deals with the formation of the D region. The important primary ionizing mechanisms are discussed together with the most probable reactions between the free electrons, ions and neutral particles. (auth)

25015 ION TEMPERATURES IN THE TOPSIDE IONOSPHERE. Dalgarno, A.; Walker, J. C. G. Planet. Space Sci., 15: 200-3 (Jan. 1967).

Theoretical calculations are made of the rates of heating and cooling of O^+, He^+ and H^+ ions by day, at 300 to 1000-km altitude. The temperatures of the H^+ and He^+ ions are computed to exceed the O^+ ion temperature by about 200°K and 50°K, respectively. The rates of flow of heat between the various charged and neutral species are also computed. (UK)

25016 THE NORMALITY OF THE SD VARIATION AT HUANCAYO AND THE ASYMMETRY OF THE MAIN PHASE OF GEOMAGNETIC STORMS. Akasofu, S.-I.; Chapman, S. Planet. Space Sci., 15: 205-7(Jan. 1967).

The fact that the SD variation at Huancayo and other dip-equatorial stations does not show the abnormal increase in amplitude well known for Sq and L indicates that the main part of the SD variation in low latitudes is not caused by an electrostatic field originating in the polar ionosphere. The major part of the SD variation in low latitudes is therefore not associated with the return current of the polar electrojet, but probably originates from a ring current which is asymmetric with respect to the dipole axis. (UK)

25017 EXAMPLES OF POSITIVE CORRELATION BETWEEN VLF CHORUS AND CNA. Morozumi, H. M. Planet. Space Sci., 15: 207-8(Jan. 1967).

Examples of simultaneous recordings of CNA and vlf chorus are reported. A definite correlation in intensity fluctuations between vlf chorus and CNA is evident, with the vlf chorus variation leading by about 32 secs. It is suggested that vlf chorus and CNA are originated by the same or related agents. (UK)

25018 MOTION OF ARTIFICIAL ION CLOUDS IN THE UPPER ATMOSPHERE. Haerendel, G.; Luest, R.; Rieger, E. (Max-Planck Institut fuer Physik und Astrophysik, Garching, Ger.). Planet. Space Sci., 15: 1-18(Jan. 1967).

An attempt is made to solve the equations of motion for an ionized irregularity of finite length, and to apply it to the behaviour of a Ba^+ cloud. After a number of simplifying assumptions, an expression for the ionospheric electric field is derived in terms of (1) the magnetic field, (2) the velocities of the neutral and ionized clouds, (3) λ^* (the ratio of the integrated Pedersen conductivities in the cloud and in the atmosphere), (4) κ_i (= gyrofrequency for Ba^+/collision frequency). The magnitude and orientation of the electric field is evaluated from the observation of six barium and strontium clouds. λ^* is assumed to be unity. The derived field strengths lie between 1 and 3×10^{-3} v/in. In the evening the fields point southward and in the early morning release northward. (auth)

25019 POSITIVE ION LAYERS IN THE E-REGION OF THE IONOSPHERE. Gleeson, L. J. (Cornell Univ., Ithaca, N. Y.). Planet. Space Sci., 15: 27-37(Jan. 1967).

The wind shear theory is used to describe the formation of "submerged" layers of minor constituent ions which have been observed in the E region with sporadic-E not necessarily present. Steady state solutions, including the effects of diffusion, are obtained for a simple but relevant model. The time scales and mode of formation are determined from solutions which neglect diffusion. Diffusion limited peaks, large compared with the normal number density of the species, can be formed by ions with recombination coefficients small compared with those of NO^+ and O_2^+. The time scales of formation might easily be 1000 sec or more. It might be possible to exploit concentrations of ions formed in this way to determine the characteristics of minor ion constituents of the E region. (auth)

25020 SATELLITES IN CONCERT. Axford, W. I. (Cornell Univ., New York). New Sci., 4: 260-2(May 1967).

Measurements on the interplanetary medium made with single satellites do not distinguish between differences from place to place and changes that occur with the passage of time. Simultaneous observations with two or more widely spaced satellites provide the solution. (auth)

25021 RELATING LARGE IONOSPHERIC INHOMOGENEITIES TO THE SUN ACCORDING TO RADIO ASTRONOMY DATA. Kokurin, Yu. L.; Ovsyankin, M. A. (Lebedev Inst. of Physics, Moscow). Radiotekh. Elektron., 11: 1688(Sept. 1966). (In Russian).

To determine the dependence of irregular refraction on the zenith angle, the Crimean Scientific Station of the Physics Institute, Academy of Sciences USSR, conducted prolonged radio astronomic observations of two discrete sources, Virgo-A and Cygnus-A, at $\lambda = 6.38$ m in zenith-angle intervals $z = 78° - 58°$ and $z = 62° - 30°$. Measurements were made using an asymmetrical radio interferometer oriented in an east–west direction. The following results were obtained: (1) An east–west asymmetry of large ionospheric inhomogeneities was noted; fluctuations of radio-wave refraction were observed in the eastern part of the sky but were almost absent in the western part. (2) An investigation of the dependence of irregular refraction amplitude on the time and the zenith angle $\Delta R_H(t,z)$ at various positions of the source in respect to the sun permits separation of angular variations $\Delta R_H(z)$ from diurnal variations $\Delta R_H(t)$. The diurnal variation data demonstrate that the refraction irregularities appear approximately one hour after the investigated region of the ionosphere is illuminated by the sun. Their amplitude approaches the maximum approximately four hours later and slowly decreases during the subsequent seven-hour period. (3) The irregular refraction amplitude $\Delta R_H(z)$ decreases with the decrease in zenith angle z. For $z = 78°$ the corresponding value of ΔR_H is 13′ to 15′; for $z = 58°$ ΔR_H is 5′ to 6′. (4) The quasiperiodic variation in irregular refraction amplitude ΔR_H was dependent upon the zenith angle. (ATD)

25022 PRELIMINARY RESULTS IN DETERMINING THE ANISOMETRY OF LARGE IONOSPHERIC INHOMOGENEITIES BY THE RADIO ASTRONOMY METHOD. Kovura, Yu. A.; Kokurin, Yu. L.; Ovsyankin, M. A. (Lebedev Inst. of Physics, Moscow). Radiotekh. Elektron., 11: 1687-8(Sept. 1966). (In Russian).

To establish the asymmetry of large ionospheric inhomogeneities, fluctuations in ionospheric refraction were determined by measuring a 47-Mc emission from the discrete source Cygnus-A within zenith angles of 45 to 25°. The study was conducted in the Crimea in November–December 1964. The two interferometers used in the study were oriented at 81 and 204° (clockwise from the south). The error of measuring fluctuations in angles of arrival of the wave did not exceed 1′. A clearly defined anisotropy of incoming wave-angle fluctuations was determined from statistical processing of 19 signal records; the rms values were 5′ and 1′ for directions 81 and 204°, respectively. The relative dimensions of large ionospheric inhomogeneities and their azimuths were computed for lenticular and sinusoidal models of inhomogeneities. The dimension ratios of large ionospheric inhomogeneities for directions 206 and 84° (layer height, 350 to 1400 km) are 3.5 for the lenticular and 1.6 for the sinusoidal models. On the basis of these data, it was concluded that the elongation of the large inhomogeneity is closer to the meridian direction then to the latitudinal. (ATD)

25023 DETERMINATION OF THE ANISOMETRY OF LARGE-SCALE IONOSPHERIC INHOMOGENEITIES BY RADIOASTRONOMIC METHODS. Kovura, Yu. A.; Kokurin, Yu. L. Radiotekh. Elektron., 11: 1543-6(Sept. 1966). (In Russian).

A method is suggested for determining the anisometry of large ionospheric inhomogeneities by using the results of measurements of irregular radioastronomic three-directional refractions. Working formulas for parameters of elliptic anisometry and orientations were obtained. (tr-auth)

25024 THE INFLUENCE OF THE STRUCTURE OF THE IONOSPHERE ON pc 3 MICROPULSATIONS. PART I. THE UNDISTURBED STATE OF THE IONOSPHERE. Hruskova, Jaroslava (Geophysical Inst., Prague). Stud. Geophys. Geod., 11: 211-20(1967).

A statistical discussion is presented of the correlation between the structure of the ionosphere, characterized by critical frequencies of the E_S and F2 layer, and micropulsations of the geomagnetic field with frequencies in the interval corresponding to pc 3. (J.H.M.)

25025 MAGNETOSPHERIC REGIONS OF AMPLIFICATION OF VLF EMISSIONS AND MICROPULSATIONS. Hruska, Antonin (Geophysical Inst., Prague). Stud. Geophys. Geod., 11: 235-40 (1967).

A numerical analysis is made of the exchange of energy between high-velocity particles and plasma waves in the magnetosphere. The positions and shapes of the magnetospheric regions of instability are estimated. It is hoped that the treatment will provide conclusions useful for the arrangement of several results concerning the appearance of instabilities in different cases of interaction. (J.H.M.)

25026 DETERMINATION OF THE ELECTRON DENSITY OF THE IONOSPHERE ABOVE 100-km ALTITUDE BY LOCAL MEASUREMENT OF THE VLF FIELD IRRADIATED BY AN EMITTER ON EARTH. Renard, Claude (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Ann. Telecommun., 21: 169-83(July-Aug. 1966). (In French).

Electron density of the ionosphere at altitudes between 100 and

200 km was determined on the basis of very-low-frequency (vlf) records obtained by the Aerobee 150 A rocket launched from Wallops Island (Virginia) receiving from a transmitter at Annapolis. The results showed that the vlf field varied strongly with the ascent and descent of the rocket between 100- and 200-km altitudes. The values obtained on ascent differed from those obtained on descent. The observed field coincided with theoretical calculations of the field at most points, especially at 110 km and at the maximum height (~185 km). The effect of gases produced by the rocket fuel on the results was considered. (BBB)

25027 DIURNAL VARIATION OF THE PREDOMINANT DIRECTION OF THE E AND H VECTORS OF SPP IN THE PLANE OF THE HORIZON AND PLANETARY RELATIONSHIP. Dymichev, B. S. (Inst. of Volcanology, Kamchatka, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 569-73(1966).

Translated from Geomagn. Aeronomiya, 6: 743-8(1966).

It is demonstrated that the E and H vectors of SPP of the electromagnetic field of the earth have a preferred direction in the plane of the horizon, determined by the geographic location of the observation point. The preferred orientation of the H vector is perpendicular to the arc of a circle which is nearly parallel to the magnetic equator, while the direction of E experiences the influence of the anisotropy of the medium. It is also shown that the E and H vectors deflect from the predominant direction: the latter varies, performing a diurnal cycle according to the local time of the observation point and the diurnal variation is associated with the precession of the magnetic axis. The conclusion is derived that there are ring currents in space near the earth that flow around the earth along circles that are parallel to the magnetic equator. (auth)

25028 RESONANCE SCATTERING OF ELECTROMAGNETIC WAVES BY SMALL DISTURBANCES IN A RAREFIED PLASMA. Zhizhimov, L. A. (Inst. of Physics, Mathematics, and Mechanics, Frunze, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 511-16(1966).

Translated from Geomagn. Aeronomiya, 6: 671-7(1966).

A theory is developed of resonance scattering of electromagnetic waves at a close to zero eigenvalue of the wave number of a plasma disturbance with an arbitrary electron density distribution. (auth)

25029 SHOCK OBSERVATIONS WITH THE EXPLORER 12 MAGNETOMETER. Kaufmann, Richard L. (Univ. of New Hampshire, Durham). J. Geophys. Res., 72: 2323-42(May 1, 1967).

Evidence that the earth's bow shock is traversed is found in magnetometer data taken on three orbits. On each of these orbits the magnetospheric boundary is crossed between 7.8 and 8.9 R_E (earth radii) near the earth–sun line, and several shock traversals are seen between here and apogee of over 13 R_E. Several shock thickness could be defined from the data. The time interval between the point the magnetic field is first observed to deviate from its interplanetary level, and the point its quiescent level first reaches the shocked value varies between 30 seconds and the minimum resolving time of the measurements (less than 2 seconds). Most of the data are consistent with the interpretation that this region consists of a much thinner shock plus several waves. A third characteristic time interval of several tens of seconds is often associated with one or more large oscillations near the shock front. These time intervals could be converted into characteristic lengths if the relative velocity between the satellite and shock front were known. The average relative velocity is determined to be about 10 km/sec, but no measurement of the actual velocity during any one traversal can be obtained. The available magnetometer measurements are consistent with several theories, and means of distinguishing between these theories are discussed. (auth)

25030 AURORAL-ZONE ELECTRON PRECIPITATION ACCOMPANYING A SUDDEN IMPULSE IN THE GEOMAGNETIC FIELD. Brown, R. R. (Univ. of California, Berkeley). J. Geophys. Res., 72: 2448-51(May 1, 1967).

Observations of bremsstrahlung accompanying a sudden impulse of 955γ in H are reported. It was found that the x-ray fluxes were soft, with e-folding energy $E_0 \simeq 13$ keV, and relatively unstructured in time; the SI precipitation was weak (~60 photons cm^2 sec ster averaged over the upper hemisphere) in comparison with auroral events; and the magnetic disturbance did not couple into or trigger the mechanism(s) responsible for the more typical forms of precipitation in the auroral zone. (J.H.M.)

25031 PROTON AND ELECTRON INTENSITY IN THE OUTER RADIATION BELT DURING THE PERIOD 1961–1964. Vernov, V. N.; Savenko, I. A.; Tel'tsov, M. V.; Shavrin, P. I. (Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 500-2(1966).

Translated from Geomagn. Aeronomiya, 6: 658-60(1966).

The results are reported of measurements in 1964 in the equatorial region of the intensity of protons with an energy ≥400 keV and of electrons with an energy >2 MeV at the center of the outer radiation belt. These results are compared with similar data obtained in 1961. (auth)

25032 STATISTICAL PROPERTIES OF PHASE FLUCTUATIONS UPON COMPLETE REFLECTION OF WAVES FROM AN IONOSPHERIC LAYER. Denisov, N. G.; Erukhimov, L. M. (Gorky State Univ., USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 531-6(1966).

Translated from Geomagn. Aeronomiya, 6: 695-702(1966).

The formation of phase and amplitude fluctuations of a signal upon reflection from an ionospheric layer is analyzed. It is shown that the signal reflection region contributes most to phase fluctuations. The frequency dependence of phase dispersion is examined for two models of the ionosphere. The results of computations are applied to the explanation of experimental data. (auth)

25033 STRATIFICATIONS AND FINE STRUCTURE OF THE E LAYER. Serafimov, K. (Geophysical Inst., Sofia). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 524-30(1966).

Translated from Geomagn. Aeronomiya, 6: 685-94(1966).

The traces appearing with a group delay above the E region can be divided into three groups: the morning-evening E2 layer (regular ionospheric layer), intensified stratified formations of quasi-periodic oscillations, and stratifications resulting from variations in the gradient of N(z) curves in the E region. These stratifications can cause the appearance of E2 and E_s layers. The results of specialized observations of stratifications in Sofia are reported. Stratifications appear in all parts of E region traces with approximately the same probability. Cases with stratifications amount to from 20 to 50% of the total number of E region observations. There are short-lived (from 0.5 to several minutes) and long-lived (with an increase in the frequency of cases of about 22 to 24 min) stratifications. As a rule, the stratifications intensify after negative disturbances, when the F region bifurcates, and when the F1 and F2 combine into F. Standard ionospheric soundings make it possible to study a large number of characteristics, except their duration. Stratifications predominate in the period from 15 to 2–3° before and after the culmination of the sun. The maximum of stratifications coincides with the forenoon delay in the growth of f_0 E(t) and, consequently, it is associated with a dynamic effect (in particular with the S_q current system). The seasonal variation, which is dependent on solar activity, of the appearance and degree of stratification is analyzed. Stratifications make it almost always possible to determine the critical frequency f_0E. It is impossible to find f_0 E only for ~10% of the measurements. (auth)

25034 SOME PATTERNS OF THE F_0 LAYER. Dubrovskaya, E. K.; Mikhailova, G. V. (Inst. of Terrestrial Physics and the Atmosphere, Ashkhabad, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 521-3(1966).

Translated from Geomagn. Aeronomiya, 6: 682-4(1966).

Some patterns in the appearance of the F_0 layer over Ashkhabad were detected in the period from March 1958 to June 1963. The seasonal probability of appearance of the F_0 layer as a function of magnetic and ionospheric activity and the space-time distribution of F_0 are examined. (auth)

25035 DIFFERENTIAL EQUATION FOR A NONSTATIONARY DYNAMO EFFECT IN THE IONOSPHERE. Ivanov, K. G. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Irkutsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 517-20(1966).

Translated from Geomagn. Aeronomiya, 6: 678-81(1966).

The differential equation of the dynamo theory of geomagnetic variations is generalized for the case of a nonstationary dynamo effect for which self-induction plays a significant role. (auth)

25036 FLUX AND SPECTRUM OF PROTONS RESPONSIBLE FOR HYDROGEN EMISSION IN AURORAS. Gal'perin, Yu. I.; Poluektov, I. A.; Sobel'man, I. I. Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 479-92(1966).

Translated from Geomagn. Aeronomiya, 6: 633-49(1966).

The effective cross sections of elementary processes accompanying the injection of low-energy protons (<30 keV) into the upper atmosphere are discussed, and the energy spectrum of the protons is reconstructed. Estimates are included of flux from the observed contour of the H_α line. It is suggested that the soft protons, which are injected in a broad band into polar latitudes, play an important role in the energy of excitation and ionization processes in "proton" auroras and in the energy balance of the upper atmosphere at polar latitudes. (J.H.M.)

25037 HF RADIO FOCUSING CAUSED BY THE ELECTRON DISTRIBUTION BETWEEN IONOSPHERIC LAYERS. Croft, T. A. (Stanford Univ., Calif.). J. Geophys. Res., 72: 2343-55 (May 1, 1967).

It is widely known that refraction by an ionospheric layer can cause radio waves to undergo skip distance focusing when ground-to-ground propagation occurs at radio frequencies above the layer critical frequency. Here it is shown by analysis and by experimental data that a similar type of spatial focusing is caused by the distribution of electrons between layers even in the absence of horizontal density gradients. The two types of focusing are conceptually similar, but they are opposite in the sense that the latter occurs at a maximum of range, whereas layer skip focusing occurs at a minimum. Associated with each type of spatial focusing is a time focusing and again, that caused by the layers themselves occurs at a minimum of time, whereas the time focusing caused by the distribution of electrons between layers occurs at a maximum. Experimental data indicate that the conditions between layers produce maximum range (or time) focusing during about half the daytime hours. The resulting signal strength on the ground is comparable to that which may be attributed to layer skip focusing. (auth)

25038 LOWER E-REGION ION CONCENTRATIONS MEASURED AT A TIME OF DECLINING SOLAR ACTIVITY. Smith, C. R.; Brinton, H. C.; Pharo III, M. W.; Taylor, H. A. Jr. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 72: 2357-63(May 1, 1967).

A positive ion mass spectrometer of the Bennett-type mounted in an ejectable payload package, was carried to 114 km above Wallops Island, Virginia, at 1330 EST in May 1962. Nitric oxide and molecular oxygen ions were the predominant species measured in the 87- to 114-km altitude range, and near 100 km they were approximately equal in concentration. Above 100 km, NO^+ increased in concentration to 113 km, where its density was 10^5 ions/cm^3, and the concentration of O_2^+ was 4×10^4 ions/cm^3. The other ions observed during the flight were 24^+ and 28^+. The ion 28^+, identified as molecular nitrogen and/or silicon, was observed between 103 and 114 km, and reached a maximum concentration of 10^4 ions/cm^3 at 113 km. The ion 24^+, identified as magnesium, was observed in two distinct layers, the lower near 93 km and the upper at 113 km; the maximum concentration of this ion was 1.5×10^3 ions/cm^3. The total ion concentration varied from approximately 4×10^3 ions/cm^3 at 90 km to 10^5 ions/cm^3 at 110 km. The fact that NO^+ and O_2^+ are of approximately equal concentration in the lower E region compares favorably with ion concentration data obtained near solar minimum by other investigators; the significance of this result is examined in the light of current theories that treat the relative importance of NO^+ and O_2^+ and the removal of N_2^+ ions in this region. (auth)

25039 LONG-TERM STUDY OF ELECTRONS TRAPPED ON LOW L SHELLS. Imhof, W. L.; Reagan, J. B.; Smith, R. V. (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 72: 2371-7(May 1, 1967).

Measurements are presented of the trapped electron environment in a narrow region of space at the lower edge of the inner radiation belt ($1.14 \lesssim L \lesssim 1.26$) for the time period from October 1962 to December 1965. Fluxes decreased during this period, although pronounced variations occurred at times of major magnetic disturbances. Measured overall decay times are relatively independent of L in this narrow region, in contrast to the sharp L dependence calculated from atmospheric scattering effects in the absence of injections. This discrepancy is particularly significant when compared with the agreement between measured and calculated decay times obtained for short quiet periods following two different magnetic storms in October–November 1963. It is concluded that other source and/or loss mechanisms, perhaps associated with L-shell diffusion, must exist in this low L-shell region in addition to atmospheric scattering and the cumulative effects of major magnetic redistributions. Although much can be learned from measurements performed in association with natural perturbations in the trapped flux, major events of this type appear to be relatively rare and are not likely to produce precisely controlled experiments. Therefore, it is suggested that a practical and preferable method of investigating the behavior of electrons in this region is by the controlled artificial injection of electrons at relatively low intensities. (auth)

25040 MAGNETIC FIELD MEASUREMENTS WITH THE IMP 2 SATELLITE. Fairfield, D. H.; Ness, N. F. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 72: 2379-2402(May 1, 1967).

The IMP 2 satellite was launched on October 4, 1964, with apogee at 15.9 R_E near the earth–sun line. Two onboard monoaxial fluxgate magnetometers measured magnetic fields in interplanetary space, the magnetosheath, and the magnetosphere during the time interval between launch and April 7, 1965. Analysis of over 325 hours of interplanetary data distributed throughout the first two months of operation revealed structuring of the interplanetary magnetic field into four recurring sectors of approximately equal size. Average fields within each sector were directed either toward or away from the sun near the theoretical spiral angle. High magnitudes and increased geomagnetic activity tended to occur early in the sectors and lower fields and quiet conditions at the end. Field directions in the magnetosheath were found to be highly dependent on the sector direction. Results suggest that fields convected through the bow shock front undergo compression and an angle change at the shock and subsequently tend to become aligned tangent to the magnetopause. Frequently both the shock front and the magnetopause were observed to move back and forth past the satellite. Comparisons with onboard plasma detectors showed very good agreement in identifying the magnetosheath. Several passes were notable for the lack of a clear magnetopause in both plasma and field data. The average magnetic field topology in the magnetosphere between approximately 9 and 16 R_E in the dawn-to-midnight region was definitively mapped. Results demonstrate solar wind distortion of the magnetosphere and the gradual formation of the magnetic tail in the dawn-to-midnight region. (auth)

25041 TIME HISTORY OF HIGH-LATITUDE ELECTRON NUMBER DENSITY AND RADIO WAVE ABSORPTION PROFILES DURING THE SOLAR COSMIC-RAY EVENT OF NOVEMBER 10, 1961. Banks, P. M. (Pennsylvania State Univ., University Park); Sechrist, C. F. Jr. J. Geophys. Res., 72: 2275-86(May 1, 1967).

The weak solar cosmic-ray event of November 10, 1961, was responsible for relatively low values of 30-Mc cosmic noise absorption at Fort Churchill and Cape Jones, Canada, and pronounced vlf propagation effects on the path from Rugby, England, to College, Alaska. Utilizing solar proton energy spectrums measured by means of the Explorer 12 satellite, it was possible to calculate the electron production rate profiles at the magnetic dip pole for the 50-hour period following the onset of the PCA event; these were used to compute equilibrium electron number-density profiles, assuming currently accepted values for the rate coefficients. A considerable enhancement of the electron number densities was found in the D region and at lower altitudes. Computed values of the 30-Mc radio-wave absorption are compared with cosmic noise absorption measured by means of 30-Mc riometers at Fort Churchill and Cape Jones, Canada. There is reasonable agreement except for times during the main phase of the PCA event. (auth)

25042 THE OSO 1 HIGH-ENERGY GAMMA-RAY EXPERIMENT. Fazio, G. G. (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.); Hafner, E. M. J. Geophys. Res., 72: 2452-5(May 1, 1967).

On March 7, 1962, OSO 1 was placed into a circular orbit with an altitude of approximately 600 km. A description is given of a high-energy γ-ray detector that was carried aboard the satellite. The detector conversion efficiency for γ-ray photons, determined by a Monte Carlo calculation, is plotted. Latitude dependence is given of γ-ray channel rates, excluding the solar sector. Time comparisons of the excess with the 2800-Mc solar radio noise, the relative sunspot number, the Climax neutron monitor (U.S. Department of Commerce, 1962), and the γ-ray detector background rate are shown. (J.H.M.)

25043 h'F VARIATIONS DUE TO NUCLEAR-GENERATED TRAVELING IONOSPHERIC DISTURBANCES. Breitling, W. J.; Kupferman, R. A. (Avco Corp., Wilmington, Mass.). J. Geophys. Res., 72: 2456-7(May 1, 1967).

Traveling ionospheric disturbances generated by high-altitude nuclear explosions were discussed by Breitling, Kupferman, and Gassmann, 1967. The disturbances were identified through the use of f_0F2 data from 54 ionospheric observations ranging in distance from 3,000 to 12,000 km from Johnston Island. The changes in f_0F2 were divided by the monthly mean f_0F2 values so as to indicate the change in electron number density; and those changes that exceeded ±0.30 and were subjectively abrupt were considered to be an indication of traveling disturbances. This work is extended through the use of the variations in the F-region virtual height. For 25 observations after the Starfish detonation, h'F were plotted with respect to time. A sample of the results is given, and a travel time curve is shown using the h'F values to determine the velocities of the h'F traveling disturbances for July 9, 1962. (J.H.M.)

25044 ON THE WINTER ANOMALY IN THE MIDLATITUDE D REGION. Maehlum, Bernt (Rice Univ., Houston, Tex.). J. Geophys. Res., 72: 2287-99(May 1, 1967).

Two causes are often proposed for the "winter anomaly," i.e., for the excess winter absorption of high-frequency waves reflected from the ionosphere at midlatitudes. It has been suggested on the one hand that meteorological effects might be responsible, but no detailed proof is available at present. The alternative explanation as being the precipitation of energetic charged particles was often rejected because of such features of the winter anomaly as its ap-

parent lack of correlation with geomagnetic activity. However, actual measurements of precipitated electrons are shown to yield good correlation with the ionospheric effects. Furthermore, it is shown that the "anomalous" absorption is correlated at magnetically conjugate stations, as one would expect if precipitated particles were responsible. It is therefore demonstrated qualitatively that the winter anomaly can be explained at least partly, as being due to precipitated electrons. (auth)

25045 THEORY OF METEOR-INDUCED MICROPULSATIONS. Jenkins, Alvin W. Jr.; DuVall, Bruce W. (Wichita State Univ., Kan.). J. Geophys. Res., 72: 2301-7(May 1, 1967).

An exact solution is found for the vector potential of the disturbance field at the surface of the earth produced by a prolate spheroidal region of enhanced conductivity in the ionospheric S_q current region. The ionosphere is treated as homogeneous and infinite in extent. Approximate expressions for the magnetic induction at the surface are derived, and application to the magnetic disturbance produced by a meteor is discussed. (auth)

25046 ANALYSIS OF THE MAGNETIC EFFECT FROM SHOWER METEORS. Green, Richard G. (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 72: 2309-13(May 1, 1967).

Magnetic effects due to the passage of the Geminid meteors through the ionosphere were computed using an equation derived by Chapman and Ashour. The observed micropulsation activity at Jicamarca, Peru, and Kingston, Rhode Island, was compared with the predicted value. No striking similarity was found either in magnitude or phase. An amplitude comparison shows an observed result 150 times greater than predicted for Jicamarca and five times greater than predicted for Kingston. The best comparison of predictions with data was restricted to a phase maxima at 2300 and 0530 LT. (auth)

25047 CONFINEMENT OF A MAGNETIC FIELD BY A BEAM OF IONS. Parker, E. N. (Univ. of Chicago). J. Geophys. Res., 72: 2315-22(May 1, 1967).

Equilibrium of a magnetic field confined by the impact pressure of a beam of ions is worked out for a general direction of incidence of the beam. It is shown that, when the beam has a velocity component parallel to the lines of force of the confined field, there is no equilibrium confinement unless there is a sufficient electron pressure in addition to the impact pressure of the ions. The impact of the ions on the field leads to a rotation of the magnetic lines of force across the boundary layer which, for the minimum electron pressure, makes the outermost lines of force perpendicular to the incident ions. If these conditions are not met, than an incident beam of ions and electrons cannot confine a magnetic field in equilibrium. It is suggested that this may be important for understanding the behavior of the geomagnetic field under the impact of the solar wind. (auth)

25048 HIGH-ENERGY β's AND γ's FROM LONG HALF-LIFE FISSION DEBRIS PRODUCTS. Carpenter, J. W.; Manley, O. P. (American Science and Engineering, Inc., Cambridge, Mass.). J. Geophys. Res., 72: 2458-9(May 1, 1967).

An examination is made of the decay schemes of ^{87}Br and ^{88}Rb following a high-altitude nuclear detonation. A combined ~5-MeV γ-ray activity curve is shown for ^{87}Br and ^{88}Rb. It is noted that the presence of significant fluxes of ~5-MeV γ's from the decays of ^{87}Br and ^{88}Rb affords a sensitive, as well as direct method of tracking fission debris products at large distances from a high-altitude nuclear detonation. (J.H.M.)

25049 ROCKET EXPERIMENTS FOR STUDIES OF D-REGION ION CONCENTRATION AND EMISSION FROM RELEASED CHEMICALS IN TWILIGHT AND AURORA. Uppsala Jonosfaerobservatorium Report No.15. Uppsala, Uppsala Jonosfaerobservatorium, 1966. 107p. Sw. kr. 15.-.

Separate abstracts were prepared for the eleven sections. (J.H.M.)

For abstracts of individual chapters see: 24255–24258 and 25050–25056.

25050 ROCKET EXPERIMENTS FOR STUDIES OF D-REGION ION CONCENTRATION AND EMISSION FROM RELEASED CHEMICALS IN TWILIGHT AND AURORA. INTRODUCTION. Stoffregen, W. (Uppsala Ionospheric Observatory). pp 7-8 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

Results of 8 rocket launchings which explored various properties of the ionosphere are discussed. Various D-region data recorded during the IGY and afterwards gave basic information about the main properties of this layer, such as latitude dependence, height variation, degree of ionization, and occurrence during different degrees of auroral activity. These studies also stimulated an interest in the ordinary D region during undisturbed conditions, which is usually not directly observable by ground-based equipments. The peculiar character of the D region, compared with the E and F regions, is determined by the high ratio of neutral air molecules and atoms to charged particles, which is of the order of 10^{12}, compared with 10^7 for the E and 10^3 for the F region. The atmosphere at the level of the D region is composed of electrons, positive and negative ions, and neutral air particles, and for the study of the electron density profile and ion distribution over the height range from 30 to 90 km a direct measuring instrument borne by a relatively small rocket was used. Also briefly described are experiments with a Gerdien condenser and observations of the occurrence of rare light emissions in twilight and in aurora. Special attention was paid to the investigation of sodium emission in aurora and twilight and of lithium emission in twilight, the latter in connection with high altitude nuclear explosions. (BBB)

25051 MEASUREMENTS OF ION CONCENTRATIONS IN THE D-REGION OF THE IONOSPHERE. Pedersen, A. (Uppsala Ionospheric Observatory). pp 9-32 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

A Gerdien condenser rocket probe was developed for collection of ions and electrons in the D region of the ionosphere. Experiments in a small wind tunnel with ionized air for determining the electrode configuration of the probe are described. The probe was launched with a Booster Arcas rocket. Data showed concentrations of positive ions of the order of 10^4 cm^{-3} and of negative ions of the order 10^3 cm^{-3} in the height range 50 to 70 km. This indicated that heavy negative ions, which cannot be collected by the Gerdien condenser, were probably present in the same height range. Heavy negative ions may be formed in chemical reactions or in clustering processes. Two rocket measurements of ion densities were later performed at Andoya, Norway, with a modified probe. The first experiment was made during quiet daytime conditions and resulted in measurements of ion densities from 30- to 90-km height. The second shot was fired during a weak auroral event, and resulted in ion density measurements from 30- to 85-km height. There was a marked difference between the daytime ion densities measured at the two places. The ion densities at Andoya were of the order 3×10^3 cm^{-3} at 30 km both during day and night. The ionization at this height was caused mainly by cosmic radiation. Daytime ion densities, both positive and negative, decreased to a min of about 2×10^2 cm^{-3} at 70 km and then increased rapidly with height. The ion densities measured during the weak auroral event exceeded the daytime ion densities by a factor of 2 in the range 60 to 70 km, and a marked peak in ion densities was observed a little below 80 km, probably because of influx of energetic electrons below the aurora. (BBB)

25052 OBSERVATIONS OF AN ARTIFICIAL SODIUM CLOUD IN TWILIGHT IN SOUTHERN FRANCE. Stoffregen, W.; Derblom, H. (Uppsala Ionospheric Observatory). pp 60-3 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

An artificial sodium cloud produced by a French Centaur rocket at Ile du Levant was studied by the auroral spectrophotometer, SP3, and cameras. The ratio D_2/D_1 of the sodium lines was recorded and found to be in agreement with theoretical values, indicating a large selfabsorption within the cloud. Photographs in black-white and in color show the development and diffusion of the cloud during about half an hour. Strong winds at about 100 km height with velocities of more than 200 m/sec were recorded. (BBB)

25053 LIGHT EMISSION FROM AN ARTIFICIAL SODIUM–LITHIUM CLOUD RELEASED IN TWILIGHT. Derblom, H.; Stoffregen, W. (Uppsala Ionospheric Observatory). pp 64-70 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

An artificial cloud produced in twilight by a new type of payload containing sodium azide and lithium azide was studied. Resonance emission from both sodium and lithium was observed by color photographs. The effect of winds on the cloud is described. The technical function of the payload was analyzed and necessary improvements of the payload are discussed. The energy of the payload seemed to be too low to create a sufficient amount of free alkali atoms in the explosion. The explosive energy has to be increased, as well as the bursting pressure of the Na–Li container, which was tested to about 50 kg/cm^2. The unexpectedly large amount of nonatomized matter resulted in a dispersion of part of the chemicals in a ballistic trajectory. (BBB)

25054 EMISSION FROM A SODIUM TRAIL RELEASED INTO AN AURORA. PART I. OBSERVATIONS 100 km SE OF THE

LAUNCH SITE. Derblom, H.; Stoffregen, W. (Uppsala Ionospheric Observatory). pp 71-82 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

An artificial trail containing 2 kg of sodium was released from a rocket-borne vaporizer in the height range 85 to 165 km during an aurora of brightness IBC II. Strong sodium emission was observed over the entire trail during the release period showing 2 pronounced intensity minima at about 90- and 132-km height. After that, the emission decreased in less than 1 min to a brightness ~1 KR, the threshold of visibility. Photometers continued to record an enhanced emission from the injected sodium up to 40 min. During this period simultaneous variations in sodium and auroral emission were observed. A strong SW wind shear with a speed of the order of 100 m sec^{-1} was observed at 95 km level. The expansion of the cloud seemed to be determined by winds rather than by diffusion. (BBB)

25055 EMISSION FROM A SODIUM TRAIL RELEASED IN AURORA. PART II. OBSERVATIONS FROM THE LAUNCH SITE. Maseide, K. (Norwegian Inst. of Cosmic Physics, Blindern). pp 83-91 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

Intensity measurements of the sodium D-lines, $\lambda = 5890-96$ Å, and the auroral nitrogen band N_2^+ 1N, $\lambda = 4278$ Å, were made with a calibrated photometer located near the launch site and directed along the rocket trajectory. During the injection period a strong increase of the sodium emission within the field of view was observed, and augmented sodium emission could be recorded until about 15 min after the release had ceased. The observations indicate that several excitation mechanisms are responsible for the augmented sodium emission. One of these seemed to be thermal excitation working within the vaporizer, and perhaps also in the sodium trail a few seconds after release. To explain the recorded emission, the long-lasting kinds of chemical excitations must be taken into account. Enhancement of the long-living sodium trail by aurora, as described in Part I, could not be found. (BBB)

25056 EXPERIENCE FROM AN ARTIFICIAL SHOCK-WAVE EXPERIMENT IN AN AURORA. Stoffregen, W.; Derblom, H. (Uppsala Ionospheric Observatory). pp 92-5 of Rocket Experiments for Studies of D-Region Ion Concentration and Emission from Released Chemicals in Twilight and Aurora. Uppsala, Uppsala Jonosfaerobservatorium, 1966.

An experiment was carried out to study the effect of a 20-kg TNT explosion in an aurora. The shock-wave from the explosion was expected to modulate the spectral emission from the aurora, and in this way make it possible to record the speed of the shock-wave. In this experiment the main interest was to test the method and to get some information concerning the temperature in an aurora. It was also expected that the local pressure increase should cause the incoming electrons to lose their energy at a slightly greater height and produce a local deformation of the aurora. Only a very feeble flash was visually observed from the detonation and it was not clear whether the absence of an artificial effect was due to some technical failure. (BBB)

25057 VYSOKOSHIROTNYE ISSLEDOVANIYA V OBLASTI GEOMAGNETIZMA I AERONOMII. (High Latitude Studies in Geomagnetism and Aeronomy). Isaev, S. I. (ed.). Moscow and Leningrad, Izdatel'stvo Nauka, 1966. 112p.

The results of studies in the area of geomagnetism and aeronomy are published. Questions of theory, morphology, and solar–terrestrial bonds of geophysical phenomena at high altitudes, ionosphere, solar radiation, geomagnetic disturbances, and cosmic radiation were examined. Observational data obtained during the international geophysical year and the international year of the quiet sun were widely used. Some conclusions were immediately related to development of methods of radioprognostication of working frequencies. (tr-auth)

Low-Temperature Physics

Refer also to abstracts 24755 and 24757.

25058 (JINR–P8-3236) OSOBENNOSTI IZMERENIYA KOEFFITSIENTOV TEPLOPROVODNOSTI MNOGOSLOINYKH IZOLYATSII. (Singularities of Measuring the Coefficients of Thermal Conductivity of Multilayer Insulations). Golovanov, L. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1967. 21p. (In Russian). Dep.

The influence of the background effect, nitrogen concentration, para-hydrogen concentration, and a number of other factors on the accuracy of determining the coefficient of thermal conductivity at the boundary temperatures 293 to 77.6°K, 293 to 20.4°K, and 293 to 4°K was found. Measuring of the heat flux, both by the quantity of the liquid vaporized and by the heater power, made it possible to estimate the effect of the heat flux, appearing at the heat exchange between the sample of the insulation investigated and the medium (edge effect), on the measurement results. Attempts were made to diminish the edge effect and to determine the errors due to this effect, while determining the coefficient of thermal conductivity of the insulation. (auth)

25059 (JINR–P8-3237) TEPLOFIZICHESKIE SVOISTVA NEKOTORYKH MNOGOSLOINYKH IZOLYATSII PRI KRIOGENNYKH TEMPERATURAKH. (Thermophysical Properties of Some Multilayer Insulations in Cryogenic Temperatures). Golovanov, L. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1967. 21p. (In Russian). Dep.

The thermal conductivity coefficients for a number of multilayer insulations are given. The dependence of the value of the thermal conductivity coefficient on the pressure in the insulation space, at different compression of insulation, was found. The coefficient of thermal conductivity was determined at the boundary temperatures 293 to 77.6°K, 293 to 20.4°K, and 293 to 4°K. The insulation was pressed from 1 g/cm^2 up to 1000 g/cm^2. The pressure in insulation space varied from 1×10^{-5} to 1×10^{-1} mm Hg. (auth)

25060 (LNF–67/6) EFFECT OF A STATIC MAGNETIC FIELD ON A SUPERCONDUCTING MILLIMETER CAVITY RESONATOR. Note No. 348. Di Paolo, L.; Baldacchini, G.; Montelatici, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Feb. 3, 1967. 7p. Dep.

The way in which the figure of merit, Q_0, is affected by a static magnetic field at different temperatures is investigated. (M.H.R.)

25061 (RHEL/R-138) CRYOGENIC PROPERTIES OF ^3He AND ^4He. Colyer, B. (Rutherford High Energy Lab., Chilton (England)). Nov. 1966. 41p. Dep. HMSO 5s. 6d.

Data on the properties of liquid and gaseous ^3He and ^4He were correlated. Values of thermal conductivity integrals for constructional materials were calculated and extrapolated down to 1°K. The results are presented as graphs. (auth)

25062 MEASUREMENT OF THE MODE OF ACTION OF A SUPERCONDUCTING FLUX PUMP. Weber, R. (Siemens Schuckertwerke AG, Erlangen, Ger.). Z. Angew. Phys., 22: 449-52(1967). (In German).

The currents and voltages generated by a superconducting flux pump were recorded, especially their variation during the motion of a normal zone carrying magnetic flux over a current-carrying superconducting sheet. The results are in reasonable agreement with the theory of Voigt. (auth)

25063 ULTRASONIC ATTENUATION OF PURE STRONG-COUPLING SUPERCONDUCTORS. Woo, James W. F. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev., 155: 429-37(Mar. 10, 1967).

The low-frequency longitudinal ultrasonic attenuation of strong-coupling superconductors is discussed. The starting point is a formula due to Kadanoff and Falko which expresses the attenuation in terms of various correlation functions. These functions were evaluated in the ladder approximation. The results are valid for all values of ql (l = electron mean free path, q = phonon wave number). In the limit $ql \gg 1$, the contribution of the density-density correlation function is dominant and Ambegaokar's result for the reduced attenuation (ratio of attenuation in superconducting to normal states) is obtained. In the limit $ql \ll 1$, all correlation functions are equally important. The reduced attenuation is a function of q and differs from the results of the BCS isotropic model. Numerical calculations for the reduced attenuation in lead were performed for various values of q which satisfy $ql \ll 1$. The results are in rough agreement with those of Deaton's experiment. (auth)

25064 BEHAVIOR OF THIN-FILM SUPERCONDUCTING BRIDGES IN A MICROWAVE FIELD. Dayem, A. H.; Wiegand, J. J. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 155: 419-28(Mar. 10, 1967).

Quantitative measurements are presented on the behavior of thin-film superconducting bridges in the presence of an applied microwave field. Classical rectification is expected when an rf signal is applied to the sample because of its nonlinear I–V characteristic. This is verified experimentally at 10 kc/sec. Deviation from classical rectification starts to occur at frequencies as low as 10 Mc, and increases with increasing frequency up to ~2 Gc, where the critical current starts to increase with the applied microwave field. The increase of the critical current with the field is more pronounced at higher frequencies and at temperatures closer to the transition temperature. De-

pendence of this behavior on frequency, power, and temperature, as well as on the width of the bridge, was studied in detail. The possibility of "microwave-induced condensation" is briefly discussed. Additional measurements were carried out on the other effects of the microwave field, namely, the production of constant-voltage steps in the I–V characteristic. It was found that the size of the steps increases smoothly over three decades of microwave power and then drops rapidly to zero. A brief comparison between bridge samples and Josephson tunnel junctions is included. (auth)

25065 NATURE OF THE AC TRANSITION IN THE SUPERCONDUCTING SURFACE SHEATH IN Pb–2 PERCENT In. Rollins, R. W.; Silcox, J. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 155: 404-18(Mar. 10, 1967).

The response of the superconducting sheath state of Pb–2 wt % In to low-frequency (20–500 cps), small amplitude (10^{-2} Oe < h_0 < 20 Oe) ac fields has been studied. Direct observation of the wave form shows that screening currents are developed in the sheath up to a critical value J_c, when the field begins to penetrate. The screening current continues to increase until a saturation value J_s is reached, at which point the current in the sheath stays constant for the remainder of the half-cycle. Fourier analysis of a model wave form for which $J_m = J_c = J_s$ indicates the harmonic content, and nonlinear nature, of the response. Measurements of the real and imaginary parts of the ac permeability, μ' and μ'', at the fundamental frequency as a function of the ac field amplitude at constant dc field shows that the transition is characterized by only one parameter, dependent on the dc field, and that the model gives an excellent description of the nonlinearity. Well-defined quantitative critical-current data can be obtained for comparison with the theories of Abrikosov, Park, and Fink and Barnes. The relationship between these observations and other measurements of μ' and μ'' as a function of dc field at constant ac field amplitude is discussed. It is shown that the transition is sensitive to misalignment of the specimen relative to the dc field. The change in the transition as the frequency is changed is explored, and a preliminary conclusion is that J_s is much more sensitive to frequency than J_c. (auth)

25066 DENSITY OF STATES OF A SHORT-MEAN-FREE-PATH SUPERCONDUCTOR IN A MAGNETIC FIELD BY ELECTRON TUNNELING. Levine, James L. (International Business Machines Corp., New York. Columbia Univ., New York). Phys. Rev., 155: 373-8(Mar. 10, 1967).

Measurements of the density of states of a thin-film, short-mean-free-path superconductor in a magnetic field are reported. The measurements were made on indium-tin films by a conventional tunneling technique. Temperatures near 0.5°K were used, in order to minimize thermal smearing. The magnetic field was in the plane of the film, and the film thickness was such that the order parameter was expected to be substantially independent of position. The results are in excellent agreement with theoretical calculations of Maki, except very close to the critical field, where small discrepancies occur. Maki's calculations predict gapless superconductivity close to the critical field, but thermal smearing prevented a direct verification. An attempt to fit the data to a BCS density of states with a field-dependent energy gap was completely unsuccessful except at zero field, where the two theories agree. (auth)

25067 SURFACE IMPEDANCE IN THE SURFACE SUPERCONDUCTING STATE. Rothwarf, Allen; Gittleman, Jonathan I.; Rosenblum, Bruce (RCA Labs., Princeton, N. J.). Phys. Rev., 155: 370-3(Mar. 10, 1967).

To enable a simple calculation of the microwave surface resistance, the surface superconducting state is approximated by a model in which a layer of uniform order parameter is considered superposed on the normal bulk. Appropriate values for the order parameter and thickness of this layer were chosen with the use of the numerical solutions of the Ginsburg–Landau equations by Fink and Kessinger. A Gorter–Casimir temperature dependence was used for the order parameter and the Maki temperature dependence for κ. These experiments on Pb–In alloys at frequencies of 9.5, 23, and 55 Gc/sec are in good agreement with the calculations. (auth)

25068 SUPERCONDUCTING PROPERTIES OF TECHNETIUM. Sekula, S. T.; Kernohan, R. H.; Love, G. R. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 155: 364-9(Mar. 10, 1967). (ORNL-P-2583).

Isothermal magnetization measurements are reported for technetium in the superconducting state from 1.5°K to the transition temperature after various stages of heat treatment up to 2000°C. The purer sample studied ($\Gamma = 120$, where Γ is the ratio of resistance at 295°K to the resistance at 9°K) was found to have a transition temperature of 7.73 ± 0.02°K, and was destroyed in an early attempt at annealing, while the second sample ($\Gamma = 97$), which had a transition temperature of 7.77 ± 0.02°K, was studied more thoroughly. The magnetic behavior of this material is characteristic of a type-II superconductor, and the experimental temperature dependence of H_{c2}, the upper critical field, is compared with existing theories. Upper limits to the thermodynamic critical field $H_c(t)$, which have been obtained by integrating under the nonreversible magnetization curves observed after the 2000°C heat treatment, lead to an extrapolated value of $H_c(0) = 1410$ Oe, and a Ginzburg-Landau parameter of $\kappa_1(1) = 0.92$. The data suggest that technetium is a weak-coupling superconductor of the BCS type, and the results are examined for self-consistency. (auth)

25069 EFFECT OF LOW-TEMPERATURE DEUTERON IRRADIATION ON SOME TYPE-II SUPERCONDUCTORS. Coffey, H. T.; Keller, E. L.; Patterson, A.; Autler, S. H. (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 155: 355-63(Mar. 10, 1967).

To study the effects of low-temperature irradiation on some type-II superconductors, the critical current density j_c, transition temperature T_c, upper critical field H_{c2}, and normal-state resistivity ρ_n were measured after irradiation with 15-MeV deuterons. The 10^{17}-deuteron/cm^2 irradiations produced about 0.3% atomic displacements. The ribbon samples consisted of Nb–61% Ti, Nb–25% Zr, Nb_3Sn, Nb, and Pb. These samples were held at about 30°K during irradiation and 5°K between irradiation and measurement. The cryostat contained a 50-kOe superconducting magnet for in situ measurements. All effects were studied after irradiation and after annealing at 77 and 300°K. The resistivities were generally increased and the transition temperatures decreased by irradiation. Changes in H_{c2} (generally reductions) are correlated with changes in T_c, ρ_n, and the Ginzburg-Landau parameter κ. Reductions of ~20% in j_c of cold-worked NbTi and NbZr were observed, whereas the only j_c effect in strain-free NbZr was the production of a peak effect near H_{c2}. Large, thermally stable j_c changes found in vapor-deposited Nb_3Sn; an increase in low-j_c material and a decrease in high-j_c material. The induced effects in the alloys and pure metals were reduced by 75% or more upon warming the samples to room temperature. For Nb_3Sn, less than 25% of the induced effects were recovered by annealing at 300°K. (auth)

25070 NEW APPROACH TO LATTICE DYNAMICS APPLIED TO SOLID ^{3}He AT 0°K. Koehler, T. R. (International Business Machines Corp., San Jose, Calif.). Phys. Rev. Lett., 18: 654-6(Apr. 17, 1967).

The expansion of a crystal potential in terms of a set of three-dimensional polynomials orthogonalized with respect to the weight function is shown to be a logical generalization of the previously introduced self-consistent harmonic approximation which is particularly appropriate for highly anharmonic systems. Explicit expressions for the calculation of the ground-state energy and phonon spectrum of a crystal at 0°K are given and certain numerical results for solid ^{3}He at 0°K are presented. (auth)

25071 COMMENTS ON THE SUPERCOOLING FIELD FOR SUPERCONDUCTORS WITH κ VALUES NEAR 0.4. Feder, J. (IBM Zurich Research Lab.). Solid State Commun., 5: 299-301 (Apr. 1967).

The possibility of having a superconducting surface sheet in a supercooled type I material is discussed in terms of the Ginzburg–Landau theory. (auth)

25072 PROXIMITY EFFECT IN SUPERCONDUCTING CONTACTS BY ELECTRON TUNNELLING. Claeson, T. (Chalmers Univ. of Tech., Goteborg); Gygax, S.; Maki, K. Phys. Kondens. Mater., 6: 23-37(1967).

The excitation spectrum in superconducting lead in the presence of a metallic contact has been investigated. Conductance-versus-voltage curves disagree with those computed from the BCS theory but agree much better with curves calculated from a depairing theory. The experiments demonstrate the existence of a pair-breaking mechanism induced by metallic contact. Tunneling into the normal side of the double layer gave less conclusive results. Because of a pair-enhancing effect, superconductivity exists in the otherwise normal metal, but it cannot be described by the simple BCS picture. A somewhat complicated temperature dependence was registered for the sharpness of the conductance-versus-voltage curves. (auth)

25073 EVIDENCE FOR ABSENCE OF ELECTRONS FROM CONDUCTION BAND IN N-InSb AT LOW TEMPERATURES. Miyazawa, H.; Ikoma, H. (Toshiba Central Research Lab., Kawasaki, Japan). Solid State Commun., 5: 229-31(Apr. 1967).

It is proposed that most electrons are absent from the conduction band, even at zero magnetic field, in n-InSb below 4.2°K. This proposal arises from hot electron and zero-field Hall coefficient data. (auth)

25074 EFFECT OF MATRIX STATE ON THE PROPERTIES OF AN ALLOY WITH A DISPERSE SUPERCONDUCTING PHASE. Romanov, E. P.; Smirnov, L. V. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved., 23: 192(Jan. 1967). (In Russian).

Heat treatment of the alloy Zr + 4 wt % Nb can result in segregation of disperse superconducting particles of a Nb-rich phase with a critical transition temperature T_{cr} that is higher than the T_{cr} of the matrix. Measurements at 4.2°K established that the system of disperse superconducting particles distributed through the normal matrix can pass a sufficiently high superconducting current. However, tests in a magnetic field showed that, despite the dispersity of the segregated phase, the critical current density decreases with increase in intensity of the magnetic field, the critical values of the field being 10 to 12 kOe. This is due to the effect of the normal-metal environment on the superconductivity of the disperse particles (the proximity effect). The state of the alloy with disperse particles in a normal matrix does not quite correspond to the spongy model, which assumes that the basis of the alloy is represented by a superconductor with lower parameters than those of the disperse particles. In this connection it was of interest to investigate the same alloy Zr + 4 wt % Nb under conditions when the matrix also converts to the superconducting state; to this end, it was sufficient to reduce the temperature of measurements to 2°K, considering that the T_{cr} of the normal quenched alloy is 2.5 to 2.7°K, and to measure critical current density at 2°K as a function of the intensity of a transverse magnetic field. Segregation of disperse particles of the superconducting phase causes a rise in T_{cr} to 8°K. While in the quenched specimen (quenching from 950°C with subsequent 82% deformation) superconductivity is destroyed at 4 kOe, in the specimen with disperse particles (quenching from 950°C with subsequent 82% deformation and tempering at 550°C) the superconducting state could not be destroyed even in a field of 24 kOe. The critical parameters of superconductivity thus markedly increase as a result of segregation of a disperse superconducting phase with a higher T_{cr}. This also points to the importance of the state of the matrix. The properties corresponding to those predicted by the spongy model occur only on segregation of superconducting particles in a superconducting matrix, whereas their segregation in normal metal does not make it possible to obtain a superconducting material with a very high critical field. (ATD)

25075 DETERMINING THE OPTIMAL CONDITIONS OF HEAT TREATMENT OF SUPERCONDUCTIVE Nb–75 PERCENT Zr ALLOY. Baranov, I. A.; Bychkov, Yu. F.; Goncharov, I. N.; Zuev, M. T.; Litomiskii, M.; Petrova, L. V.; Ruzhichka, I.; Fil'kin, V. Ya.; Shmulevich, R. S. (Joint Inst. of Nuclear Research, Dubna, USSR). Fiz. Metal. Metalloved., 23: 145-50(Jan. 1967). (In Russian).

The effect of annealing conditions and cold deformation on the critical current density (j_c) and ductility of superconductive Nb–75% Zr alloy wire coated with an 0.05 to 0.07-mm-thick copper layer has been investigated. The alloy was melted in an electron-beam furnace. Wire specimens 0.4 to 1.35 mm in diameter were annealed at 400 to 570°C for 1 to 10 hr and cold drawn to a diameter of 0.2 to 0.33 mm. It was found that annealing for about 30 min improves ductility. Prolonged annealing lowers ductility. The j_c sharply increases during the first 30 min of annealing. Longer annealing has little or no effect. The j_c behavior is associated with changes in microstructure and phase composition. In wires 1.35, 0.8, and 0.4 mm in diameter, annealed at 500°C for 1 hr and then drawn to a diameter of 0.2 mm, the amount of cold deformation had little or no effect on j_c in magnetic fields of medium intensity. However, in strong magnetic fields the j_c increased substantially with increased reduction. Even low reductions substantially increased the j_c in strong magnetic fields. Since the wire ductility is decreased by high reduction, a compromise is proposed to obtain a wire with high j_c values and satisfactory ductility by process-annealing the wire at a diameter several times larger than the final diameter and omitting the final annealing. Wire, process-annealed at 400 to 500°C for about 1 hr and cold-drawn to final dimensions, had good superconductive properties and satisfactory ductility and strength. It is expected that it will find wide application in solenoids with magnetic fields of over 50 to 60 kgauss intensity. (ATD)

25076 PHASE DIAGRAM OF THE NIOBIUM–TITANIUM–ZIRCONIUM SYSTEM AND SUPERCONDUCTING PROPERTIES OF ITS ALLOYS. Alekseevskii, N. E.; Ivanov, O. S.; Raevskii, I. I.; Stepanov, N. V. (Inst. of Metallurgy, Moscow). Fiz. Metal. Metalloved., 23: 28-36(Jan. 1967). (In Russian).

A study has been made of several alloys of the niobium–titanium–zirconium system at five sections with a constant niobium content of 6, 12, 30, 50, and 70%. Alloys were melted from 99.7%-pure iodide zirconium, 99.8%-pure iodide titanium, and 99.7%-pure cermet niobium. Phase diagrams of the system at 500, 550, 600, and 800°C were plotted on the basis of obtained data. It was found from the phase diagrams that the area of splitting into two solid solutions $\beta_{Nb} + \beta_{Zr}$ gradually narrows with the introduction of titanium into the alloys. At temperatures below 525°C, ternary alloys of the area adjacent to the niobium corner of the system are in a two-phase state $\beta_{Nb} + \alpha_{Ti-Zr}$. The one-phase area of β_{Nb} solid solution at 550 to 500°C juts out into the ternary system along the line bisecting the niobium angle of the diagram. An even decrease of the critical temperature of transition to the superconducting state was observed in alloys that were in the state of β solid solution and were subjected to a high degree of cold deformation (96% reduction). At a complete replacement of zirconium with titanium, this decrease was 1 to 2°K. In sections at 30 and 50% (Ti + Zr) of alloys cold-deformed and annealed at 550°C, only a small decrease of critical current density in a field of 20,000 oersteds was noticed when about half the zirconium was replaced with titanium. (ATD)

25077 LAMINATED SUPERCONDUCTING STRIP. Shmidt, V. V. (Inst. of Metallurgy, Moscow). Fiz. Metal. Metalloved., 22: 621-2(Oct. 1966). (In Russian).

The critical parameters of laminated superconducting strips, made by combining thin superconducting strips parallel to each other and separating them with dielectric material are determined theoretically. Laminated superconductors can carry larger critical currents in a strong magnetic field (H_0) which is parallel to the surfaces of these strips. An equation is given for the ratio between the strength of a magnetic field on the surface of a thin strip for a given critical current and the critical field of the bulk material as a function of the depth of penetration of a weak magnetic field, the Ginsburg–Landau parameter, the critical field of the strip, the half thickness of a layer, and H_0. The Maxwell relation is also given for the critical moment when each layer of the strip carries the critical current. The simultaneous solution of these two equations gave the distribution of critical current through the cross section of the strip in the absence of an external magnetic field. (ATD)

25078 THERMODYNAMIC BEHAVIOR OF THIN SUPERCONDUCTING FILMS. Kirzhnits, D. A.; Maksimov, E. G. (Lebedev Inst. of Physics, Moscow). Fiz. Metal. Metalloved., 22: 520-8 (Oct. 1966). (In Russian).

The calculation of thin films, like that of any other inhomogeneous system, is greatly complicated by the nonlinearity of superconductivity equations. Hence most previous studies pertain to the case of weakly inhomogeneous superconductors whose inhomogeneity scale is large compared with the ordering parameter ξ_0 or the free-path length l. The article deals with an opposite case, namely, that of films whose thickness is low compared with ξ_0 but, of course, high compared with the mean distance between particles. "Pure films" ($l \gg \xi_0$) with an interaction constant that varies over their thickness are considered, on assuming constancy of the characteristics of the normal properties of the substance (effective mass, etc.). The thermodynamic properties of such films are shown to be identical with those of homogeneous bulky specimens (provided that the interaction constant is adjusted to its mean over the film thickness). Some additional solutions of superconduction equations arise, however, owing to film-boundary effects and the inhomogeneity of distribution of electrons across the film. The stability of these additional solutions is relative rather than absolute. The large gradient terms predicted by the Ginzburg–Landau theory, which would disturb the coincidence between the thermodynamic potentials of the film and the homogeneous specimen, play only an insignificant role in this case, since the films are sufficiently thin ($\sim 10^{-6}$ cm). (ATD)

25079 EXPERIMENTS ON DILUTION OF ^{3}He WITH ^{4}He AT VERY LOW TEMPERATURES. Vilches, O. E.; Wheatley, J. C. (Univ. of Illinois, Urbana). Phys. Lett., 24A: 440-2(Apr. 24, 1967).

Measurements are reported of thermal effects associated with dissolving ^{3}He in ^{4}He at very low temperatures. Experiment and theory are in essential agreement. A temperature of 4.5 m°K is attained without recourse to magnetic cooling. (auth)

25080 POSSIBLE EXACT MOMENTUM PAIR-BREAKING MECHANISM DUE TO UMKLAPP PROCESSES IN SUPERCONDUCTORS. Lo, S. C.; Wong, K. W. (Univ. of Kansas, Lawrence). Phys. Lett., 24A: 433-5(Apr. 24, 1967).

An attempt is made to show that it is possible to obtain nonexact opposite-momentum pairings in the presence of an external magnetic field if the electrons in superconductors are strongly coupled to the transverse phonons as well as to the longitudinal phonons usually assumed in the BCS–Bogolyubov theory. (auth)

25081 TEMPERATURE DEPENDENCE OF THE CRITICAL FIELD H_{c1} IN SOLID-SOLUTION Nb–Ta ALLOYS. Ogasawara,

T.; Kubota, Y.; Yasukochi, K. (Nihon Univ., Tokyo). Phys. Lett., 24A: 463-4(Apr. 24, 1967).

The temperature dependence of the upper critical field H_{c2} is studied on the whole composition range of Nb–Ta alloys. The results are in accord with the theoretical prediction made by Maki. (auth)

25082 SPECIFIC HEAT OF GADOLINIUM METAL AT VERY LOW TEMPERATURES. Dreyfus, B.; Michel, J. C.; Thoulouze, D. (CEN, Grenoble, France). Phys. Lett., 24A: 457-8(Apr. 24, 1967). (In French).

The hyperfine coupling in gadolinium metal has been investigated by specific heat measurements at very low temperatures. H_{eff} is found equal to (380 ± 20)kOe. In a Y–Gd alloy, the experimental value H_{eff} is lower than expected with virtual bound state. (auth)

25083 EFFECT OF RESONANCE SCATTERING AND d–d CORRELATIONS ON THERMODYNAMIC PROPERTIES OF SUPERCONDUCTING ALLOYS. Kiwi, M.; Zuckermann, M. J. (Univ. of Virginia, Charlottesville). Phys. Lett., 24A: 456-7 (Apr. 24, 1967).

The critical magnetic field and electronic specific heat are calculated for dilute superconducting alloys of simple metals with transition metal impurities. The impurities do not sustain a magnetic moment and therefore a model due to Anderson may be used. The results are applied to Al–Mn alloys. (auth)

25084 ENTROPY AND SPECIFIC HEAT OF SUPERFLUID HELIUM AT THE LAMBDA POINT. Ferrell, R. A.; Menyhard, N.; Schmidt, H.; Schwabl, F.; Szepfalusy, P. (Univ. of Virginia, Charlottesville). Phys. Lett., 24A: 493-5(Apr. 24, 1967).

The critical change in the entropy is calculated. As in experimental tests, the theory predicts anomalous dispersion of second sound in bulk He II and a logarithmic dependence of the specific heat of a He II film upon its thickness. (auth)

25085 THERMODYNAMICS OF VORTEX FLOW IN SUPERCONDUCTORS. Yntema, G. B. (United Aircraft Research Labs., East Hartford, Conn.). Phys. Rev. Lett., 18: 642-5 (Apr. 17, 1967).

An expression is derived for the force which is applied to a straight vortex line in a superconductor by the combination of electric currents and a thermal gradient. (auth)

25086 DENSITY OF ROTATING He II. Smith, E.; Walton, R.; Bohm, H. V.; Reppy, J. D. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 18: 637-8(Apr. 17, 1967).

Results are presented of measurements of the density of rotating He II using two different methods. Dielectric-constant and pycnometer techniques were employed. The measurements do not confirm earlier reported density increases. (M.O.W.)

25087 SUPERCONDUCTING TRANSITION TEMPERATURE AND ELECTRONIC STRUCTURE IN THE PSEUDOBINARIES Nb_3Al–Nb_3Sn AND Nb_3Sn–Nb_3Sb. Bachner, F. J. (Massachusetts Inst. of Tech., Lexington); Goodenough, J. B.; Gatos, H. C. J. Phys. Chem. Solids, 28: 889-95(May 1967).

The system $Nb_3Al_ySn_{1-y}$ exhibits complete solid solubility, a positive Seebeck voltage that increases monatomically from 1.8 to over 12 $\mu V/°K$, and a superconducting transition temperature T_c that has a broad minimum of $T_c \approx 15.3°K$ at about y = 0.5. The pseudobinary $Nb_3Sn_{1-x}Sb_x$, on the other hand, contains two phases, each with the A15 structure, in the interval $0.3 < x < 0.8$. Whereas the Seebeck voltage of the low-Sb phase is positive and has $T_c > 14°K$, the high-Sb phase has a negative Seebeck voltage and is not superconducting above 4.2°K. These properties are interpreted with the aid of a qualitative band-structure scheme. Thus, the rapid drop in T_c to below 4.2°K in the system $Nb_3Sn_{1-x}Sb_x$ is believed to be associated with the filling of the bonding interchain d_π bands of the Nb subarray. (auth)

25088 CONTRIBUTION TO THE EXPERIMENTAL STUDY OF SURFACE SUPERCONDUCTIVITY. Deutscher, G. (CNRS, Orsay, France). J. Phys. Chem. Solids, 28: 741-82(May 1967). (In French).

In high magnetic fields some materials are superconducting only in a superficial sheath of thickness ξ_T (typically 1000 Å), where ξ_T is the coherence length at temperature T. Theoretical prediction of this effect was given by Saint-James and de Gennes [Phys. Letters, 7: 306(1963)]. Experiments on thin films are described to show the existence of this sheath, to study how its properties vary as a function of the applied magnetic field, and to measure directly its thickness. The influence of the proximity of a normal metal on surface properties of the superconducting film was also studied. (auth)

25089 EFFECT OF MICROINHOMOGENEITY ON THE CRITICAL POINTS OF SUPERCONDUCTING ALLOYS. Pakhomov, V. Ya.; Kunakov, Ya. N.; Kachur, E. V.; Lainer, D. I. Fiz. Metal. Metalloved., 22: 640(Oct. 1966). (In Russian).

The effect of a homogenization anneal on the critical current density of Nb–46% Ti was studied. The purpose of this heat treatment was to eliminate intercrystalline liquation which exists in the as-cast alloy. It is known that the Lorentz force can cause a creep of magnetic current that may result in the loss of superconductivity. Different types of metallic defects (inhomogeneities, dislocations, internal stresses, etc.) may act as stabilizers against the creep. For the experiments, a 40-gram ingot was melted in a radiant arc furnace with tungsten electrodes in a purified helium atmosphere and homogenized in a vacuum furnace at 1500°C. The homogenized ingot was cold reduced into 0.25 mm diameter samples. All samples had similar cold reductions. Critical current densities were measured in a transverse magnetic field of 16 kOe at 4.2°K. The critical current density is given as a function of ingot homogenization time which ranged from 1 to 5 hours. The critical current density for Nb–46% Ti decreased linearly from about 1.8×10^4 A/cm² in the as-cast condition to about 10^4 A/cm² after 5 hours of ingot homogenization. All of the samples had a similar dislocation density of 10^{11} to 10^{12} cm^{-2}, characteristic of severely deformed metals. The microstructure of as-cast ingots showed intercrystalline liquation, which decreased as a function of homogenization time. After 5 hours at 1500°C, almost all of the liquation was absent in both alloys. Analogous results were obtained in Nb–75% Zr in which the critical current density after homogenization changed from 1.3×10^4 to 7.8×10^3. (ATD)

25090 MOTION OF IMPURITIES AND THE SPECTRUM OF EXCITATIONS IN LIQUID ^4He. Burke, T. (Univ. of Birmingham, Eng.); Major, K. G.; Chester, G. V. Ann. Phys. (N. Y.), 42: 144-72(Mar. 1967).

The effective mass of a helium-3 impurity in helium-4 and the spectrum of elementary excitations in pure helium-4 are calculated. Both these calculations are carried out within the framework of the Feynman–Cohen variational method. The variational equation for the backflow field for the impurity is solved exactly and it is found that it is of dipole form at large distances but deviates from this form at short distances. The best value of the effective mass is about 1.75 m_3. This exact solution is used to calculate the energy spectrum of the elementary excitations. The value of the roton minimum is 11.0°K. Both these results are somewhat sensitive to the detailed form of the liquid structure factor, which has to be taken from experiment. The physical properties of the impurity and excitation wavefunctions are examined and it is tentatively suggested that the roton minimum represents a transition point at which single-particle excitation becomes possible. (auth)

25091 WAVE RESISTANCE OF SUPERCONDUCTORS IN THE INTERMEDIATE STATE. Andreev, A. F. Zh. Eksp. Teor. Fiz., 52: 1106-17(1967). (In Russian).

It is shown that in the presence of a direct current the electromagnetic oscillation spectrum of the intermediate state of superconductors of the first kind with unequal numbers of electrons and holes is such that Cherenkov emission of radiation by static inhomogeneities should be possible. The wave resistance which is thus produced is calculated. A characteristic feature of the resistance is its strong dependence on the nature of the inhomogeneities. If the latter are periodic a large number of resonance maxima are observed on the resistance versus current curve. For a sufficiently pure metal the wave resistance is much greater than the usual value value. (auth)

25092 ABSORPTION OF ULTRASOUND IN SUPERCONDUCTING ALLOYS IN THE MIXED STATE. Galaiko, V. P.; Fal'ko, I. I. Zh. Eksp. Teor. Fiz., 52: 976-85(1967). (In Russian).

The absorption coefficient of long wave ultrasound (longitudinal and transverse) in an impure superconducting alloy in the mixed state was calculated in the local approximation. The magnetic field was not assumed to be very large, $H_{c1} < H_0 \ll H_{c2}$. Total absorption consists of two parts, of absorption due to viscosity of the electron gas and absorption due to viscosity of the vortex lines. Due to the first absorption mechanism the local value of the sound absorption coefficient is defined, irrespective of the polarization by a certain isotropic function of temperature and velocity of the superconducting condensate which is not identical with the local value of the BCS function $2(e^{\Delta/T}+1)^{-1}$. After averaging over the vortex lattice in a weak field the absorption coefficient was calculated. The second mechanism involves excitation of independent oscillations of the vortex lattice by the sound wave and also losses due to viscous motion of the vortices. This part of the absorption is strongly anisotropic depending on the direction of propagation of the sound wave and the polarization and is characterized by a complex dependence on the magnetic field. (auth)

25093 INVESTIGATION OF FRACTIONATION OF A HELIUM ISOTOPE MIXTURE IN UNPACKED COLUMNS. Grigor'ev,

V. N.; Esel'son, B. N.; Mikheev, V. A.; Tolkacheva, O. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 52: 871-4(1967). (In Russian).

Fractionation of $^3He-^4He$ mixtures in miniature unpacked columns was studied at temperatures of 2.16 and 1.5°K. The possibility of employing such columns for extraction of ^3He from solutions with a low content of the light isotope was demonstrated. It is suggested that unpacked columns may be used for obtaining high-purity ^3He. (auth)

25094 SUPERCONDUCTING PROPERTIES OF RHENIUM. Alekseevskii, N. E.; Mikheeva, M. N.; Tulina, N. A. Zh. Eksp. Teor. Fiz., 52: 875-81(1967). (In Russian).

The effect of compressive plastic flow on the superconducting characteristics of massive rhenium samples was investigated. A discontinuity was observed on the curve of the dependence of the critical temperature of the deformed samples at the value of $1/a = r\,(4{,}2°K)/r(300°K)$. The discontinuity was attributed to the appearance of a new crystallographic modification of Re. In the range of not very large deformations the ratio H_{k2}/H_{km} linearly depends on 1/a; with increase of the deformation the deviation from linearity becomes larger. The characteristic parameter κ grows with increase of the deformation: this indicates that deformed Re changes from a superconductor of the first kind to a superconductor of the second kind. The maximal value of κ observed in massive samples is two. The superconducting properties of Re layers evaporated in vacuum were investigated, the behavior of the layers being very similar to that of nontransition metals freshly precipitated at low temperatures. The values of κ and δ_{00} were calculated on basis of the experimental data. (auth)

25095 SHIFT OF THE LIMITING ENERGY OF BISMUTH ELECTRONS IN A MAGNETIC FIELD. Pelikh, L. N.; Eremenko, V. V. Zh. Eksp. Teor. Fiz., 52: 885-90(1967). (In Russian).

The oscillations and shift of the Fermi level were measured in bismuth single crystals at liquid helium temperature in pulsed magnetic fields up to 50 kOe. The results are in good agreement with those of previous works. Data on the observed spin splitting of Landau levels are presented. (auth)

25096 MEASUREMENT OF THE ANISOTROPY OF THE ENERGY GAP IN SUPERCONDUCTING INDIUM BY AN ULTRASOUND METHOD. Fil, V. D.; Shevchenko, O. A.; Bezuglyi, P. A. Zh. Eksp. Teor. Fiz., 52: 891-6(1967). (In Russian).

The temperature dependence of the absorption coefficient of longitudinal ultrasound in superconducting indium was measured along the principal crystallographic axes for the small sound field amplitude regime. On the basis of these measurements the anisotropy of the energy $2\Delta(0)$ for the effective interaction zones and the sound absorption coefficients a_n in the normal state were determined. The possible effect of topology of the indium Fermi surface on the results of the measurements is discussed. (auth)

25097 EFFECT OF DIMENSIONS ON THE THERMAL CONDUCTIVITY OF CRYSTAL ^4He SAMPLES. Mezhov-Deglin, L. P. Zh. Eksp. Teor. Fiz., 52: 866-70(1967). (In Russian).

The dependence of the thermal conductivity of crystal ^4He samples on their dimensions was investigated. The crystals were grown in 4.2-, 2.47-, and 1.6-mm-diameter glass ampoules at a constant pressure of 85 atm. The critical size of the crystal at which the effect of Poiseuille flow of the phonon gas on the thermal conductivity is appreciable is about 1.3 mm for the crystals. The effective normal collision phonon mean free path is calculated on basis of measurements of the thermal conductivity in the Poiseuille flow region. At the lowest temperatures specular scattering of phonons on the walls of the glass ampoule significantly affects the thermal conductivity of the samples. (auth)

25098 THEORY OF THE DENSITY OF STATES OF PURE TYPE-II SUPERCONDUCTORS IN HIGH MAGNETIC FIELDS. Brandt, U.; Pesch, W.; Tewordt, L. (Univ., Hamburg). Z. Phys., 201: 209-21(1967).

The theory of the density of states of pure type-II superconductors in high magnetic fields is considered. An approximate expression of the Green's function is derived by using the fact that it has the periodicity of the lattice of flux lines in the center-of-mass coordinates. In comparison to the normal state Green's function a correction term proportional to the absolute square of the order parameter arises. This is seen to act as a self-energy part depending strongly on the polar angle Θ of the "quasi-particle" momentum relative to the direction of the field. The corresponding density of states, as a function of the excitation energy, is found to vary from the gapless to the BCS type as the parameter Θ changes from $\pi/2$ to zero (or π). The averaged state density varies gradually from a uniform to a BCS-like state density as the external field decreases sufficiently far below the upper critical field. The results of the theory for the averaged density of states agree fairly well with the results due to a conjecture by MAKI if the field is very close to the upper critical field. (auth)

25099 AC SUPERCONDUCTING SOLENOID FOR KILOGAUSS FIELD MODULATION. Kurtin, Stephen; Foner, Simon; McNiff, Edward J. Jr. (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instrum., 38: 600-1(May 1967).

The design of an ac superconducting solenoid capable of producing oscillatory magnetic fields having peak-to-peak amplitudes as large as 1000 G at frequencies up to 500 Hz with only moderate dissipation is discussed. It is shown that a simple, inefficient coil geometry (thin solenoid) is suitable. Tests with an ac superconducting solenoid used as a modulation coil in a 60 kG superconducting magnet are described. Results indicate that the performance of copper at 4.2°K is far surpassed by Nb–25% Zr over a wide range of operating conditions. (auth)

25100 CRYOGENIC SYSTEMS. Barron, Randall. McGraw-Hill Series in Mechanical Engineering. New York, McGraw-Hill Book Co., 1966. 690p. $17.50.

An introduction to the engineering aspects and challenges of cryogenics is presented. Emphasis is placed on the design and analysis of systems used to produce, maintain, and utilize low temperatures. The text is an outgrowth of class notes and lecture material associated with a course in cryogenic systems and is slanted primarily toward senior mechanical engineering students. (W.D.M.)

Plasma and Thermonuclear Physics

Refer also to abstract 24964.

Confinement and Heating of Plasma

Refer also to abstract 25168.

25101 (66-C-483) HIGH-CURRENT TEST FACILITY EMPLOYING CAPACITOR DISCHARGE AND LOW-FREQUENCY PULSE TRANSFORMER. Westendorp, W. F. (General Electric Co., Schenectady, N. Y. Research and Development Center). Dec. 1966. 26p.

In a number of cases such as circuit breaker tests, triggered vacuum gap tests, magnetization of special magnets, a current pulse in the range of 100 kA to 1 MA and a duration of a few milliseconds is required. With the availability of a 600-kJ capacitor bank in the GE Research and Development Center, and the associated ignitron switching equipment, a coreless low-frequency pulse transformer was designed and built permitting tests up to a 300,000-A peak, and in the case of current interruption, recovery voltages at a peak of 850 volts, corresponding to 600 V-rms. Circuits and circuit constants are given for this particular installation. Design criteria for the low-frequency, high-current pulse transformer are discussed. (auth)

25102 (CEA-R-3115) MOUVEMENT D'UNE PAIRE ELECTRON–ION DANS UNE BOUTEILLE MAGNETIQUE EN PRESENCE D'UNE ONDE PROGRESSIVE A LA RESONANCE CYCLOTRON ELECTRONIQUE. (Movement of an Electron–Ion Pair in a Magnetic Bottle in Presence of a Progressive Wave in Cyclotron Electronic Resonance). Brami, Felix; Consoli, Terenzio; Ichtchenko, Georges (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1967. 40p. (In French). Dep.

The particle motion is studied in the complex field configuration of a CIRCE machine, by mean of an analogic computer as a function of initial conditions (an electromagnetic wave propagates along the z axis of a magnetic bottle and produces electron cyclotron resonance at one or both the mirror regions, depending on the attenuation distance). It is shown that the electromagnetic wave can prevent particles from escaping into the loss cone. An analytical solution is found, which is in good agreement with the analogic results. (auth)

25103 (LA-DC-8086) THE ENGINEERING ASPECTS OF THE LASL SCYLLAC PROPOSAL. Kemp, E. L. (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract W-7405-eng-36. 33p. (CONF-661016-35). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From Symposium on Engineering Problems of Controlled Thermonuclear Research, Gatlinburg, Tenn.

Scyllac is a proposed toroidal theta-pinch machine to be built at the Los Alamos Scientific Laboratory. The major diameter is 15 meters, minor diameter 10 cm. The primary capacitor bank will store 10 MJ at 60 kV and deliver 134 MA with a rise time of 3.8 μsec. The system will also include a preionization bank, 130 kJ at 40 kV, a quadrupole stabilization bank, 2 MJ at 60 kV, a mirror stabilization bank, 2 MJ at 60 kV, and a bias field bank, 2 MJ at

10 kV. All banks will be crowbarred. The machine will look like a segmented washer in plan view with the load coil on the inside radius. Each segment will consist of two 2 in. aluminum alloy current collector plates held together with insulated through-bolts. The bolts will be incorporated into a cartridge that serves as a cable termination for 12-load cables. The design features of the collector system and the cable cartridge will be discussed. Scyllac will require a new 2-μF, 60-kV capacitor, reliable high-voltage, low-inductance coaxial cable, new 4-element start spark gaps and crowbar gaps. These components are under active development and the status of each will be presented. The system design philosophy will be discussed. (auth)

25104 (LA-DC-8087) EVALUATION OF COAXIAL CABLE PERFORMANCE AT HIGH VOLTAGES. An Interim Report. Boicourt, G. P. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 21p. (CONF-661016-33). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From Symposium on Engineering Problems of Controlled Thermonuclear Research, Gatlinburg, Tenn.

Coaxial cables have been used extensively as high-voltage transmission lines between capacitor banks and experimental plasma loads. The large number of cables now being used at Los Alamos in the theta-pinch devices makes it imperative to obtain highly reliable, low-inductance, high-voltage cable. A program has been inaugurated to develop reliable 17/14 type, double-braided, low-inductance cable to operate at 50 to 85 kV. A test program has been initiated to establish criteria for evaluating cable designs and operating reliability. The first phases of the program are described. Three tests are used, two pulse discharge tests and a 60-Hz ac test. The first pulse discharge test uses a 2-μF, 50-kV capacitor and spark gap to pulse charge a 0.1-μF capacitor through six cables being tested. This subjects the test cable to 57 kV at the 2-μF capacitor termination and to 78 kV at the 0.1-μF capacitor termination. The second pulse test uses six additional cables from the 0.1-μF capacitor to an open termination under oil. The open termination produces additional voltage on the second group of cables. The ac test is designed to subject 100 feet of cable to 60-Hz ac voltages up to 85-kV rms. The tests are described in detail, preliminary results are given, and the correlation between the pulse discharge tests and the steady state ac test is discussed. (auth)

25105 (UCRL-70070) FAILURE REPORTING AND ANALYSIS SYSTEM FOR THE ASTRON FUSION REACTOR LINEAR ACCELERATOR. Willows, J. L.; Bartholomew, A. G. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 29, 1966. Contract W-7405-eng-48. 18p. (CONF-670504-2). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 21st Annual Technical Conference on The American Society for Quality Control, Chicago, Ill.

A failure analysis was made of the Astron 4-MeV electron linear accelerator. The failure analysis procedure is outlined. (M.O.W.)

25106 CALCULATIONS OF MAGNETIC FIELDS WITH ROTATIONAL SYMMETRY ACCORDING TO GIVEN MAGNETIC FORCE LINES. Afanas'ev, E. F.; Morozova, E. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 73-6(Sept.-Oct. 1966). (In German).

Calculations of magnetic fields with rotational symmetry demand that the given line be a magnetic force line (i.e., that the given rotation surface would coincide with the magnetic force surface). A solution is developed for the case when the given line is a straight line. Further, the solution is generalized for the case of an arbitrary smooth line resolved by the approximation of its broken line. Applications are discussed. (R.V.J.)

25107 ARRANGEMENT OF CURRENT CONDUCTORS FOR THE MIN. B FIELD. Sometani, Taro; Yamamoto, Kenzo (Nagoya Univ., Japan). J. Phys. Soc. Jap., 22: 1065-9(Apr. 1967).

An arrangement of current conductors producing the minimum $\overline{B}$ field of the periodic multipole type is given. If the current conductors are suitably arranged on some cylindrical surfaces with radii small compared with an axial pitch, the deviation of field lines from the axis can be kept so small that the by-axial calculation of the field components is allowed. (auth)

25108 PLASMA CONFINEMENT IN TOROIDAL TRAPS WITH DESTRUCTED MAGNETIC SURFACES. Kadomtsev, B. B. Zh. Eksp. Teor. Fiz., 52: 1039-48(1967). (In Russian).

It is shown that the destruction of magnetic surfaces in toroidal traps due to the presence of external disturbances or to imperfection of the coil design should result in a plasma leak of the order of the Bohm leak in a broad range of variation of the plasma parameters. (auth)

Diagnostics of Plasma

Refer also to abstracts 24253 and 25133.

25109 (CEA-R-3161) PROFILS DES RAIES SPECTRALES Ly α, Ly β, ET H α DE L'ATOME H EN PRESENCE D'UN CHAMP MAGNETIQUE DANS UN PLASMA. (Spectral Ly α, Ly β, and H α Line Shapes for the H Atom in the Presence of a Magnetic Field in a Plasma). Nguyen, Hoe; Drawin, Hans-Werner; Herman, Louis (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb. 1967. 93p. (In French). (EUR-3245.f). Dep.

Numerical data are given of the line shapes of Ly α, Ly β, and H α for the following parameters: $1 \times 10^2 \leq H\ [gauss] \leq 1.2 \times 10^5$; $1 \times 10^{15} \leq N\ [cm^{-3}] \leq 1 \times 10^{18}$; and $1 \times 10^4 \leq T\ [°K] \leq 4 \times 10^4$; where H = magnetic field strength, N = density of plasma ions, and T = electron temperature. (auth)

25110 (CEA-R-3165) DISTRIBUTION DES ENERGIES ELECTRONIQUES DANS UN PLASMA FAIBLEMENT IONISE. (Electron Energy Distribution in a Weakly Ionized Plasma). Cesari, Claude (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1967. 141p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay, France.

Theoretical and experimental studies were made to view the type of distribution function for the electron energies existing in a positive-column-type cold laboratory plasma having an ionization rate of between 10^{-6} and 10^{-7}. The theoretical analysis, based on the imperfect Lorentz model and taking into account inelastic collisions, is developed from the Boltzmann equation. The experimental method for making an electrostatic analysis of the electronic energies makes use of a Langmuir probe used in conjunction with a transistorized electronic device. A comparison between the experimental and theoretical results yields information concerning the mechanisms governing electron energy transfer on a microscopic scale. (auth)

25111 (IHT-1-17) EICHNORMALE FUER EINE NEUE METHODE ZUR MESSUNG DES PROFILS DER ELEKTRISCHEN LEITFAEHIGKEIT IN KREISZYLINDRISCHEN PLASMEN. (Calibration Standard for a New Method for Measurement of the Profile of Electric Conductivity in Circular Cylindrical Plasmas). Burkhardt, H.; Hirsch, K. (Technische Hochschule, Stuttgart (West Germany). Institut fuer Hochtemperaturforschung). Sept. 1965. 73p. (In German). (CONF-660448-2). Dep. mn.

From Meeting of the Professional Group on Plasma and Gas Discharge Physics, Kiel, Germany.

Construction materials of Cu or graphite plastic mixtures with electric conductivities lying in the area of light arc plasmas were developed and investigated. From the new construction materials a tube system of six different diameters was prepared. This system permits, through arrangement of suitable tubes, the preparation of a number of seven-stage conductivity profiles which can be used as calibration standards for measurement of the electric conductivity in plasmas by the induction method. The calibration curves for a two-stage profile were given. (tr-auth)

25112 (LRP-30/67) ANALYSEUR DE RAIES SPECTRALES UTILISANT UN INTERFEROMETRE DE FABRY-PEROT MULTICANAL. (Spectral Line Analyzer Used in a Multichannel Fabry-Perot Interferometer). Berney, A. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)). Mar. 1967. 14p. (In French). Dep.

A multichannel spectral analyzer well adapted to the measurement of Doppler broadening in plasmas is described. The main constituent is a Fabry-Perot interferometer with a particularly stable system of fine adjustment of the order of interference. Criteria of selection of the entrance monochromator are also presented. (auth)

25113 (N-67-11698) SURVEY OF CLASSICAL LANGMUIR PROBE THEORY WITH APPLICATIONS TO FLOWING IONIZED GASES. Interim Report. Schwartz, Simon H. (Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics). Oct. 1964. 25p. (NASA-CR-79367; PIBAL-845). CFSTI $3.00 cy, $0.65 mn.

The use of Langmuir probes in ionized gas flows is investigated. First the basic theory of electrostatic probes is investigated and the regimes in which the classical theory is applicable are noted; then a survey is made of literature which modifies the basic theory when the assumptions of classical theory are not met. A survey is then made of literature dealing with the application of basic probe theory to a flowing ionized gas. The modified equations are given. The possible sources of error are enumerated. Finally, recommendations are made as to when the classical Langmuir probe can be used in an ionized gas flow, and the equations to use it are given where applicable. It is determined that in most cases

the classical theory can be used, with the basic equations unmodified by the flow. In some cases a modification is necessary and the equations are supplied. (auth)

25114 (N-67-12078) SHOCK TUBE SPECTROSCOPY AT CHROMOSPHERIC TEMPERATURES. Research Progress Report, October 1965-July 1966. Wilkerson, T. D. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Aug. 1966. 26p. (NASA-CR-79762; BN-467). CFSTI $3.00 cy, $0.65 mn.

Results of recent spectroscopic experiments with a gas-driven shock tube are described, including technical developments, progress in redundant measurements of plasma state, and data on atomic line strengths for neutral carbon. (auth)

25115 (NP-16718) MESSUNGEN MIT GASDYNAMISCHEN SONDEN AN EINEM UEBERSCHALLPLASMASTRAHL. (Measurements With Gasdynamic Probes in a Supersonic Plasma Jet). Krause, S. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt E. V., Stuttgart (West Germany). Institut fuer Plasmadynamik). July 1966. 42p. (In German). (DLR-FB-66-49; DVL-546). Dep.

A certain number of independent measurements (depending on the degree of nonequilibrium of the plasma) with gasdynamic probes is required to determine unambiguously all thermodynamic properties and the speed of a flowing plasma. An example demonstrates how, by the aid of a working diagram, it is possible to derive graphically the unknown properties from the measured values. First measurements with gasdynamic probes of static pressure, local stagnation pressure, local mass flow, and local stagnation enthalpy of a supersonic plasma jet emerging from an electrothermal plasma accelerator are discussed, and show satisfying results. A new local stagnation enthalpy probe constructed for plasma jets with low local energy flow (e.g. for a heavily expanded supersonic plasma jet) is described. The experiments described are to be understood as a first step to explore diagnostically the modern electric thrustors with magnetic or self-magnetic acceleration. (auth)

25116 (NRL-6541) CALCULATIONS USEFUL IN THE DETERMINATION OF ELECTRON TEMPERATURE FROM X-RAY CONTINUUM RADIATION EMITTED FROM HIGH-TEMPERATURE PLASMAS. Elton, R. C.; Anderson, A. D. (Naval Research Lab., Washington, D. C.). Jan. 18, 1967. 38p.

The results of calculations of the total integrated bremsstrahlung radiation passing through absorbing foils of beryllium, aluminum, and nickel [as well as aluminum and nickel in combination with carbon (polyethylene)] are presented for various temperatures and a range of useful thicknesses. Such information is necessary in obtaining values for the electron temperature in a plasma from measurements of the soft x-ray continuum emission. The spectral distribution of the transmitted radiation is also presented for use in determining the spectral region observed, thereby avoiding regions of undesirable radiation. An indication of an observable flux level in a typical experiment is given, along with equations suitable for scaling to other plasma conditions, as a further aid in selecting foils for a particular application. (auth)

25117 SPECTRUM OF SCATTERED LASER RADIATION AND MEASUREMENT OF ELECTRON CONCENTRATION IN A PULSED PLASMA. Besshaposhnikov, A. A.; Voloshin, A. E.; Kuchuberiya, I. Kh.; Sidorov, V. P.; Simonova, N. V. Zh. Prikl. Spektrosk., Akad. Nauk BSSR, 6: 172-5(Feb. 1967). (In Russian).

The spectrum of scattered radiation received at the pulsed rf plasma during laser beam probing is discussed. The satellites are interpreted as a result of Raman scattering by plasma oscillations due to electron drift. The method and the results of electron density measurements by scattered radiation intensity are given. (auth)

25118 ON THE SO-CALLED MULTIPARAMETER METHODS FOR THE DIAGNOSIS OF AN OPTICALLY DENSE PLASMA. Preobrazhenskii, N. G. Opt. Spectros. (USSR) (Engl. Transl.), 21: 134-5(Aug. 1966).

Translated from Opt. Spektros., 21: 232-4(Aug. 1966).

Methods for evaluation of plasma postulated by Ilin and Fishman (Opt. Spectros. (USSR) (Engl. Transl.), 20: 214 (1966)) are criticized. The diagnostic assumptions made in obtaining information from the shape of a reabsorbed spectral line are discussed. Fallacies in these assumptions and the nature of the resulting errors are pointed out. (A.G.W.)

25119 MEASUREMENT OF THE CONCENTRATION OF ELECTRONS IN A PULSED XENON DISCHARGE USING A GAS LASER. Rozanov, A. G.; Cheburkin, N. V.; Shvindt, N. N. Opt. Spectros. (USSR) (Engl. Transl.), 21: 416-17(Dec. 1966).

Translated from Opt. Spektros., 21: 761-2(Dec. 1966).

The measurement of electron density in a pulsed discharge using a laser interferometer is described briefly. The curve obtained for electron concentration as a function of time closely reproduces the current curve. The maximum concentration is 7.0×10^{17} cm^{-3}. (A.G.W.)

25120 SPECTROSCOPIC AND PROBE STUDY OF A CONTRACTED DISCHARGE COLUMN. II. Golubovskii, Yu. B.; Kagan, Yu. M.; Lyagushchenko, R. I. Opt. Spectros. (USSR) (Engl. Transl.), 21: 295-7(Nov. 1966).

Translated from Opt. Spektros., 21: 525-31(Nov. 1966).

The distribution of emission intensity over the cross section of a positive column in neon and argon was studied under various conditions. The results are in agreement with contracted discharge column theory. (auth)

25121 DIFFRACTION OF A PLANE ELECTROMAGNETIC WAVE BY AN INFINITE SET OF PARALLEL METALLIC PLATES IN AN ANISOTROPIC PLASMA. Wu, C. P. (Bell Telephone Labs., Whippany, N. J.). Can. J. Phys., 45: 1911-23(May 1967).

The diffraction of a plane electromagnetic wave by an infinite set of parallel metallic plates is considered. The plates are assumed to be vanishingly thin and infinitely conducting, and are immersed in a cold plasma which is rendered anisotropic by an external magnetostatic field parallel to the edges of the plates. An exact solution is obtained by using the Wiener–Hopf technique for the case in which the fields have no variation in the direction of the external static magnetic field. It is found that, because of the anisotropy of the medium, the reflection becomes nonvanishing for the TM mode incident normally at the interface between the parallel plates and the free plasma regions. Also, the reflection coefficient is no longer an even or odd function of the angle of incidence. When the degree of anisotropy is relatively small, the results practically reduce to those in an isotropic dielectric, except that the phase functions of the reflection and transmission coefficients would experience a rapid variation for small incident angles. Some numerical examples showing the effects of anisotropy are given. (auth)

25122 LASERS AND PLASMA DIAGNOSTICS. Watson, J. L. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Atom, No. 127, 123-8(May 1967).

It is forecast that lasers may become standard laboratory tools for studying plasma behavior. A wider application to shock phenomena may follow. Work on plasma production by focused laser beams is well advanced and laser-produced plasmas are being used for spectroscopic analysis of materials. Carbon dioxide and argon lasers of increasing power are becoming available, and may have a part to play in plasma physics. Possibilities are plasma density measurements and Faraday rotation measurements made continuously over an entire plasma history. Mention is made of a new liquid laser (neodymium in selenium oxychloride) which may outmode present concepts of high power and energy. Laser research at AWRE, Aldermaston, is described. (UK)

25123 METHOD FOR THE DIRECT DETERMINATION OF THE CONDUCTIVITY PROFILES IN PLASMAS. Burkhardt, H.; Rapp, H. (Technische Hochschule, Stuttgart). Z. Naturforsch., 21a: 2102-4(Dec. 1966). (In German).

A method is given for the direct determination of the conductivity profile in plasmas. The method is based on measurement of the impedance as a function of the frequency. Numerical solutions are given for the frequency function. Experimental measurements were made on two stage graphite models with which the pattern of some profile types can be approximated. (J.S.R.)

25124 RESONANCE PROBE THEORY. Samokhin, M. V. (Inst. of Radio Engineering, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 578-84(1966).

Translated from Geomagn. Aeronomiya, 6: 754-61(1966).

The increase in the constant high-frequency electron current on a resonance probe is determined for the case when the constant negative potential is high. It is shown that the width of the resonance peak in a collisionless plasma is inversely proportional to the ratio of the probe potential to the plasma temperature, while the resonance frequency is lower than the plasma frequency and the shift of these frequencies decreases as the absolute magnitude of the probe potential increases. (auth)

Kinetics of Plasma

Refer also to abstracts 25001, 25028, and 25110.

25125 (CTS-PA-67-1) LANDAU DAMPING IN A RELATIVISTIC PLASMA. Kursunoglu, Behram (Miami Univ., Coral Gables, Fla. Center for Theoretical Studies). May 1967. Contracts AF 49(638)-1260; NASA NGR 10-007-010. 11p.

It is shown that over a time interval $\tau = 4\pi mc/(e|\epsilon|)$ the phenomenon of Landau damping, for electron mass small compared to κT, can induce a cooling mechanism in a relativistic plasma by an

"amplification" of longitudinal as well as of transverse waves. (auth)

25126 (IHT-1-21) FREQUENZANALYSE DER SCHWANKUNGSERSCHEINUNGEN AM PLASMABRENNER. (Frequency Analysis of the Oscillation Phenomena in Plasma Burners). Burkhardt, H.; Vinnemann, A.; Zeyfang, E. (Technische Hochschule, Stuttgart (West Germany). Institut fuer Hochtemperaturforschung). Nov. 1965. 54p. (In German). (CONF-660448-3). Dep. mn.

From Meeting of the Professional Group on Plasma and Gas Discharge Physics, Kiel, Germany.

The oscillations of the burner voltage and of the beam brightness as well as the emitted sound occurring in a plasma burner were subjected to a frequency analysis. The characteristic frequencies observed were measured as a function of the mass throughput, type of gas injected, electrode distance, and the burner geometry. The oscillations were explained by periodic vortex cleavages which were investigated previously on cold gas beams. The equations derived for cold gas beams were expanded to the high temperature region. The frequency values obtained agree in the upper regions with the measurement results. (tr-auth)

25127 (N-67-11358) MICROWAVE INTERACTION WITH LABORATORY PLASMA CONFINED IN A DIPOLAR MAGNETIC FIELD. Quinn, Robert G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1966. 25p. (NASA-TM-X-55576; X-615-66-239). CFSTI $3.00 cy, $0.65 mn.

An experimental technique has been devised to measure the scattering of microwave radiation from a plasma coated magnetized sphere. The relevant literature is reviewed, and the experimental apparatus and techniques are described. Preliminary results of attenuation and phase shift are presented, which indicate that the plasma properties can be determined using this technique. In addition the results provide the radar cross section of a sphere clad with plasma having configurations varying from a spherical shell to a disc. (auth)

25128 (N-67-12041) STRUCTURE OF THE CURRENT SHEET IN A PINCH DISCHARGE. Burton, Rodney L. (Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences). Sept. 1966. 145p. (NASA-CR-80057). CFSTI $3.00 cy, $0.65 mn.

Thesis.

The structure of a propagating current sheet in a cylindrical pinch discharge in argon is studied experimentally and analytically. The azimuthal magnetic field, B_θ, is mapped throughout the discharge, yielding patterns of current density, $\vec{j}$. From an inventory of the $\vec{j} \times \vec{B}$ distributions, it is deduced that the bulk of the gas is accelerated to the current sheet velocity. The patterns of radial electric field, E_r normal to the current sheet, are mapped with a coaxial floating double probe. Based on a one-dimensional, constant compression model, the E_r field appears to be of sufficient magnitude to allow conduction of all axial current by electrons in collisionless $\vec{E}_r \times \vec{B}_\theta$ drift, this field is not strong enough, however, to accelerate ambient ions to the sheet velocity, suggesting that gasdynamic forces also participate in the interaction. This model also identifies ohmic heating in the sheet with the product of radial ion current density and E_r. Comparative measurements in neon, argon, and krypton, keeping the ambient mass density constant, indicate that this ohmic heating decreases with increasing molecular weight. (auth)

25129 (N-67-12223) IONIC SOUND WAVES IN PLASMAS. Final Report. Calvert, James B. (Denver Univ., Colo.). Sept. 1966. 15p. (NASA-CR-79287; DRI-2359). CFSTI.

Apparatus for the study of collision-dominated pressure waves in a plasma has been designed. The plasma is a direct-current glow discharge in ultrapure helium. Acoustic pulses are generated by a diaphragm and detected by an electron-mobility-type microphone. (auth)

25130 (N-67-13538) THEORETICAL AND EXPERIMENTAL STUDIES OF HIGH TEMPERATURE GAS TRANSPORT PROPERTIES. Final Report, May 11, 1964-May 10, 1965. (Avco Corp., Wilmington, Mass. Research and Advanced Development Div.). May 10, 1965. Contract NASw-916. 172p. (NASA-CR-80649; RAD-TR-65-7). CFSTI.

Column voltage gradients and radial temperature distributions have been measured at several current levels for cylindrically symmetric electric arcs in argon and nitrogen. These data have been analyzed to obtain thermal conductivity as a function of temperature by integrating the Elenbaas-Heller energy equation. The effects of emission and absorption of far ultraviolet radiation have been studied using information available in the literature. It is concluded that these ultraviolet effects are probably responsible for the 40% discrepancy between the experimental and theoretical conductivities of argon, and the much larger discrepancies occurring in nitrogen. Approximate interaction potentials between ground-state atoms and atomic ions at large internuclear separations have been calculated for the systems $N-N^+$ and $O-O^+$ using a generalization of the Heitler-London method. The unperturbed atoms and ions were represented by analytic Hartree-Fock wavefunctions from the literature, including all electrons of each system. The calculated interaction potentials have been used to evaluate the average cross sections for charge exchange and diffusion in these systems, neglecting the polarization effect. (auth)

25131 (N-67-13679) MAGNITUDE OF NONLINEARITIES IN COLLISIONLESS MAGNETOPLASMA WAVES. Woollett, Richard R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan. 1967. 35p. (NASA-TN-D-3778). CFSTI.

A perturbation technique is used to obtain approximate solutions to the nonlinear hydromagnetic equations (Ohm's law and the equation of motion of a fluid element) of a cold collisionless plasma. The assumed model consequently consists of (1) a linear harmonic wave that is infinite in extent, and (2) nonlinear waves that are harmonic and propagate in the direction of the fundamental. The perturbation technique limits application to regions where nonlinearity is small. Some idea of the importance of the nonlinearity can be obtained by observing the magnitude of the terms. For a transverse perpendicularly propagating wave in atomic hydrogen, nonlinear effects are shown to be important near and below a frequency of 10^7 second^{-1} for a fundamental amplitude of a statvolt per centimeter or greater and for a plasma density of 10^{12} ions/cm^3 and a magnetic field intensity of 10^4 gauss. For a longitudinal perpendicularly propagating or a right or left circularly polarized wave, nonlinear effects are only important for very large wave amplitudes. (auth)

25132 (NASA-TN-D-3947) TIME-DEPENDENT STRUCTURE OF ONE-DIMENSIONAL MAGNETIC COMPRESSION WAVES IN COLLISIONLESS PLASMAS: OBLIQUE AMBIENT MAGNETIC FIELD. Rossow, Vernon J. (National Aeronautics and Space Administration, Moffett Field, Calif. Ames Research Center). May 1967. 43p. CFSTI.

Numerical analysis is made of the structure of one-dimensional unsteady magnetic compression waves propagating into collisionless plasmas when the ambient magnetic field is oblique to the wave direction. In the case studied, both the subcritical and supercritical solutions changed continuously from one limiting situation to the other. A similarity rule was found for correlating the subcritical cases so that the two-parameter family of solutions in mass ratio and field angle were reduced to a single set. (auth)

25133 (SRRC-CR-66-48) STUDY OF PULSE DISPERSION IN PLASMA. Final Report, May 16, 1964-September 30, 1966. Meitz, G.; (and others) (Sperry Rand Research Center, Sudbury, Mass.). Dec. 1966. Contract AF19(628)-4183. 28p. (AFCRL-67-0159). CFSTI.

The results are summarized of research conducted during the interval 16 May 1964 to 30 September 1966 for the Air Force Cambridge Research Laboratories. The research is grouped into three topics: (1) pulse dispersion, (2) longitudinal waves in warm plasmas, and (3) diagnostic applications of electroacoustic resonances. (auth)

25134 (AD-646276) FLOW OF STRONGLY RAREFIED PLASMA AROUND A CHARGED BODY. Pashchenko, N. T. Translated from Arch. Mech. Stosow., 16: 521-8(1964). 15p. (FTD-HT-66-290). CFSTI.

The problem of a strongly rarefied plasma flow around a charged body has been investigated by many authors with a majority of investigations devoted to plasma oscillations. In this case the body is considered as a point, and boundary condition problems were studied. Jastrow and Pears assumed a potential field around the body as a spherical symmetrical and found a solution analogous to the Debye solution, but the assumption adopted by them did not actually consider the body's oncoming. A case is discussed in which the Debye radius is large in comparison to the characteristic dimension of the body, which is not applicable during the investigation of body movements in the ionosphere, where a reversible relation takes place. The reports used in solving the equation for the potential of iteration methods did not give the possibility of detecting the characteristic phenomenon of the boundary layer which gives a rapid change in potential in the vicinity of the body and the given expressions for the potential are valid only at a great distance from the body. In addition, errors in determining the ion density were committed which involved errors in determining the potential. (auth)

25135 CALCULATION OF THE SELF-CONSISTENT FIELD IN A PLASMA HIGH-FREQUENCY ACCELERATOR. Brambilla, Marco (CEN, Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 264: 514-16(Feb. 13, 1967). (In French).

The calculation of the electron orbits in the acceleration of a plasma by a high-frequency field with right circular polarization in the presence of a static magnetic field gradient makes it possible to resolve the Boltzmann–Vlasov equation. The field produced by the accelerated plasma can thus be calculated in the nonrelativistic approximation. (tr-auth)

25136 STUDY ON CONTINUOUSLY WORKING, AXIALLY SYMMETRIC PLASMA MACHINE WITH ELECTROMAGNETIC ACCELERATION. Kruelle, G.; Ungerer, E. (DVL, Institut fuer Plasmadynamik, Stuttgart). Raumfahrtforschung, 11: No. 1, 14-20(Jan.-Mar. 1967). (In German).

The principal possibilities of the application of electromagnetic forces for the acceleration of plasmas, i.e., self-magnetic and Hall acceleration, are briefly discussed. Some devices built for operation on such principles are described. These model thrustors were operated at about 1000 A and an ambient pressure of 0.5 mm Hg, mainly with argon. In case of selfmagnetic acceleration an increase with current of the exit Mach number was observed. The exit velocity, however, was moderate and the fraction of aerodynamic to total acceleration was high. When an external field was applied the thrust, average exit velocity, and total efficiency were increased substantially with the applied field strength. Using He and H_2, velocities up to 50,000 m/s could be calculated from thrust data. The characteristic features of the exhaust flow were observed to be determined mainly by the shape of the external field. (auth)

25137 INVERSE FARADAY EFFECT IN A PLASMA. Pomeau, Yves; Quemada, Daniel (Univ., Paris, Orsay, France). Compt. Rend., Ser. B, 264: 517-18(Feb. 13, 1967). (In French).

The creation of a significant magnetization in a plasma when the plasma is submitted to the action of a circularly polarized wave was studied. This magnetization is the inverse effect of the Faraday rotation of a wave being propagated in a magnetoplasma. A simple model of it was studied and some orders of magnitude for an experimental project were given. (tr-auth)

25138 INFLUENCE OF THERMAL RADIATION ON ELECTRONS IN A HIGH-TEMPERATURE PLASMA. Biskamp, D.; Pfirsch, D. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Z. Naturforsch., 22a: 145-7(Feb. 1967).

The velocity space diffusion coefficient of electrons in a thermal radiation field is derived "classically" and compared with the corresponding Fokker–Planck coefficient arising from Coulomb collisions in a plasma. The Hamilton–Jacobi theory is used which is especially suited to this problem. (auth)

25139 DIFFUSION OF TEST PARTICLES IN A RELATIVISTIC ELECTRON PLASMA. Elsaesser, Klaus (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Z. Naturforsch., 22a: 147-52(Feb. 1967). (In German).

The dynamical friction and diffusion coefficients of a relativistic electron plasma (kinetic energy kT comparable with rest energy mc^2) are calculated in the Landau approximation. The deviations of these quantities from their classical limits are shown and interpreted mainly as kinematical effects due to the different relation between the kinetic energy and the velocity. (auth)

25140 CALCULATION OF SHOCK FRONT PARAMETERS IN A PLASMA. Ahlborn, B.; Salvat, M. (Institut fuer Plasmaphysik, Garching, Ger. Univ. of British Columbia, Vancouver). Z. Naturforsch., 22a: 260-3(Feb. 1967).

Introducing an effective ratio of the specific heats, exact values for the shock front parameters can be obtained, if thermal equilibrium may be assumed. Exact values for the shock front parameters in a singly ionized nonequilibrium plasma can be obtained only if one of the end values is measured. (auth)

25141 INTENSITY OF SPECIFIC HEAT FLUX IN JETS OF HIGH-FREQUENCY ELECTRODELESS PLASMATRON IN THE AIR. Kononov, S. V.; Yakushin, M. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 67-8(Nov.-Dec. 1966). (In Russian).

Results are given of an experimental investigation of specific thermal fluxes developed in the high-frequency electrodeless plasmatron jets in air. Tabulated data on measurements of the thermal flux in plasma jets and in chemical flames are included. At identical conditions the magnitudes of maximum specific thermal fluxes on cylindrical and plane surfaces were identical. (R.V.J.)

25142 ELEMENTARY PROCESSES IN THE PLASMA OF A DC GAS DISCHARGE IN HELIUM. Tolmachev, Yu. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 224-5(Sept. 1966).

Translated from Opt. Spektros., 21: 397-8(Sept. 1966).

The discrepancy at high pressures between calculated and experimental values of the populations of excited states of atoms in the plasma of a gas discharge is considered. The assumption of step-wise excitation apparently does not account for the discrepancy. Calculations based on the assumption that the decay of the upper levels occurs mostly because of collisions with atoms in the nonexcited state and the populating proceeds stepwise give better results. (A.G.W.)

25143 PLASMA GENERATOR: A HIGH-TEMPERATURE HEAT SOURCE. Cioca, V. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 18: 1055-60(1966). (In Rumanian).

Plasma heating makes it possible to reach very high temperature with relative ease. The method is based on the formation of the plasma state of matter, characterized by high conductivity and very elevated temperatures. Plasma generators were found very useful for preparing metal and metal-oxide powders from halides, for obtaining single crystals and metal carbides and other refractory materials, for carrying out fractionate distillation and sublimation operations, and for thermal shock tests. The generator used for laboratory experiments represented a gas-stabilized system, allowing dissipation of 10 to 15 kW(e). The arc could be started rapidly by short-circuiting through a shunt and could be supplied with a number of gas mixtures. It operated with a 110- to 220-V electric supply. The gases used included nitrogen with a 1% oxygen admixture and additional admixtures of hydrogen or argon. Tangential or axial injection methods could be used as desired. The temperature reached, as determined from the Stokes curves, was found to be about 12,000°K. (TTT)

25144 DISPERSION RELATIONS OF MOVING STRIATIONS. Yoshimoto, Hiroshi; Yamashita, Yoshihiko (Okayama Univ., Japan). J. Phys. Soc. Jap., 22: 1087-93(Apr. 1967).

In order to make clear the wave nature of moving striations, the dispersion relations were measured in rare gases, mercury–rare gases, and hydrogen gas by modulating the discharge current at an adequate audio-frequency signals, and the experimental formula of dispersion relation was deduced. In case of the positive moving striations the dispersion curve in ω-k frame is approximated by a hyperbolic one, while in case of the negative moving striations by a straight line. Generally the dispersion curve depends on the discharge current used, and in the positive moving striations there are two different types of the dependence on current: one is called "rare gas type" and the other "mercury–rare gas type." The group velocity expected from the experimental formula of dispersion relation is ascertained to coincide with the velocity of wavepacket excited artificially. (auth)

25145 TRANSVERSE SCATTERING OF A PARTICLE BY AN ENSEMBLE OF RANDOM ALFVEN WAVES. Asseo, Estelle; Berthomieu, Gabrielle (Institut d'Astrophysique, Paris). Compt. Rend., Ser. B, 264: 687-9(Feb. 27, 1967). (In French).

The coefficients of scattering perpendicular to the magnetic field of a test particle of a plasma in which a group of random Alfven waves are being propagated were calculated. (tr-auth)

25146 SPECTROSCOPIC STUDY OF DISINTEGRATING HELIUM PLASMAS AT 20°K. Fugol, I. Ya.; Pakhomov, P. A.; Shevchenko, Yu. F. Opt. Spectros. (USSR) (Engl. Transl.), 21: 404-7(Dec. 1966).

Translated from Opt. Spektros., 21: 741-8(Dec. 1966).

The kinetics of disintegration of helium plasmas at 20°K was studied spectroscopically. Pair collision probabilities and diffusion coefficients of the metastable atoms were determined. The mechanism of helium plasma afterglow at 20°K is discussed. (auth)

25147 ELECTRON–ION RECOMBINATION IN A PLASMA. Abramov, V. A.; Smirnov, B. M. Opt. Spectros. (USSR) (Engl. Transl.), 21: 9-12(July 1966).

Translated from Opt. Spektros., 21: 19-26(July 1966).

Electron–ion recombination in a plasma resulting from electron collisions in the field of the ion is investigated. The electron captured by such a process makes transitions between excited states of the atom, although, owing to radiation, it does not drop into the ground state. The case of practical interest in which either the frequencies of transitions due to collisions and radiation are comparable for the higher excited atomic states, or the plasma temperature is low, is examined. In this case the recombining electron spends most of its time in higher excited states of the atom so that the recombination coefficient does not depend upon the type of atoms and ions constituting the plasma. An analytical function of the plasma density and temperature is obtained for the recombination coefficient, with the Born approximation being used in the calculation of the cross section for inelastic scattering of an electron by a strongly excited atom. (auth)

25148 DISTURBANCE OF A RAREFIED PLASMA BY A SUPERSONIC BODY ON THE BASIS OF THE POISSON–VLASOV EQUATIONS. I. THE HEURISTIC METHOD. Taylor, J. C. (London Univ. United Kingdom Atomic Energy Authority, Abingdon, Eng.). Planet. Space Sci., 15: 155-87(1967).

A boundary-value problem for the Poisson–Vlasov equations, arising from the study of supersonic flow of rarefied plasma over a body, has been solved in two ways. An iterative method is given in detail. It is shown that an excellent zero order approximation to the solution is obtained by treating the ions as neutrals. The difficult first order correction to the ion distribution function is then found. The Poisson equation is solved numerically and results are given for the zero order potential field. The ion density to zero and to first order are compared, showing important differences. In particular, the first order solution exhibits a trailing V-wave of increased ion density of half angle ≈10°, thickness $\approx 2\lambda_D$ and with its vertex a Mach number of body radii downstream of the obstacle. A possible explanation of this effect is given. (auth)

25149 HIGH-FREQUENCY SURFACE WAVES ON INHOMOGENEOUS PLASMA COLUMNS. Granatstein, V. L. (Bell Telephone Labs., Inc., Whippany, N. J.); Korn, P.; Ojo, A.; Schlesinger, S. P. J. Appl. Phys., 38: 1969-71(Mar. 15, 1967).

Dipolar waves are launched onto the surface of a positive column afterglow. Dispersion characteristics are obtained over a more extensive range of parameters than previously examined; phase velocity, ω/k_z, ranged from 0.94c to 0.27c and signal frequency is high ($\lambda_0 \approx 2\pi R$). The waves are forward near the light line ($\omega/k_z \approx c$), but become backward waves as ω/k_z decreases. Experimental results are compared with an analysis that uses the full set of Maxwell's equations (nonquasistatic) but which adopts a dielectric-clad homogeneous plasma cylinder as a model of the discharge tube. This analysis qualitatively predicts the major dispersive features. In particular, as circumference to free space wavelength ratio, $2\pi R/\lambda_0$, increases, the magnitude of group velocity in the backward wave region decreases; also the peak in the dispersion curve becomes less sharp and its position recedes farther from the light line. However, lack of quantitative fit between experimental results and analytical predictions indicates the need for a theoretical model which accounts for plasma inhomogeneity. (auth)

25150 ARBITRARY CURRENT SOURCE IN A HOMOGENEOUS ANISOTROPIC PLASMA. van Hulsteyn, David B. (Army Research Office, Durham, N. C.). J. Appl. Phys., 38: 1567-73 (Mar. 15, 1967).

In analogy with the free-space solution of Maxwell's equations, the excitations which are set up in an anisotropic, macroscopically neutral plasma by an arbitrary current can be described by potentials. The equations which the one vector and two scalar potentials must satisfy are first obtained for a relatively general physical situation. Due to the complexity of the mathematics, however, one cannot expect to obtain analytic solutions to this set of coupled equations without first making some realistic simplifications. One particular case that can be solved without an inordinate amount of difficulty is that of the point charge moving with uniform velocity parallel to a strong magnetic field. It is shown that the propagating waves which arise in this situation are electroacoustic in nature but very different from those created by a moving charge in an isotropic plasma. (auth)

25151 KINETIC THEORY OF PLASMAS: INELASTIC COLLISION OPERATOR IN THE CASE OF ELECTRONIC EXCITATION AND DE-EXCITATION. Peyraud, Nelly (Faculte des Sciences, Orsay, France). J. Phys. (Paris), 28: 147-51(Feb. 1967). (In French).

In order to study the evolution of the distribution of electron velocities in a plasma, an expression is given for the inelastic and superelastic collision operator figuring in the second member of the Boltzmann equation; in the special case of collisions between electrons and heavy particles, this operator is linear. The mathematical properties of this operator are studied; problem of eigenfunctions and eigenvalues; it is shown that the eigenfunctions are spherical harmonics, and the eigenvalues are calculated. (auth)

25152 IONIC WAVES IN PLASMA INTERACTING WITH BEAM OF CHARGED PARTICLES AT GREAT RELAXATION TIME. Martinov, N.; Stainov, G. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 25-7(1967).

Ionic waves in homogeneous plasma, located in a constant external homogeneous electric field and interacting with a beam of charged particles at Maxwell velocity distribution of electrons, ions, and beam particles, are described by a dispersion equation. Solutions of the dispersion equation are considered. (W.D.M.)

25153 ELECTRON RECOMBINATION IN A WEAKLY IONIZED GAS. Veselovskii, I. S. (Moscow Physical-Technical Inst.). Zh. Eksp. Teor. Fiz., 52: 1034-8(1967). (In Russian).

The recombination coefficient between electrons and ions in triple collisions in a neutral gas was calculated. The calculation was performed on the basis of the Boltzmann equation. The result is close to the Thomson value. (auth)

25154 MACROSCOPIC DESCRIPTION IN STABILITY PROBLEMS OF A COLLISION PLASMA IN A STRONG MAGNETIC FIELD. Mikhailovskii, A. B. Zh. Eksp. Teor. Fiz., 52: 943-54 (1967). (In Russian).

A new method is developed for solving the Boltzmann kinetic equation for a totally ionized plasma located in a magnetic field. The assumptions underlying the method are those which are characteristic of the stability problems of a collision plasma and which differ from the assumptions of the usual theory of transfer phenomena. A set of macroscopic equations for a zero pressure plasma in a straight magnetic field is derived which describes drift processes in a plasma more correctly than the Braginsky equation. (auth)

25155 RADIATION PROCESSES IN PLASMAS. Bekefi, G. Wiley Series in Plasma Physics. New York, John Wiley and Sons, Inc., 1966. 388p. $15.75.

Experiments and theory on the emission, absorption, and scattering of electromagnetic waves in gaseous plasmas are presented. Only those radiative processes that have to do with changes in the external motions of the constituent electrons, ions, and atoms are included. Wave propagation and energy flow in an anisotropic plasma and generalizations of the classical radiation laws applicable to anisotropic, nonthermal media are discussed. First, effects are described that do not depend primarily on the presence of an external magnetic field as, for example, bremsstrahlung of transverse electromagnetic waves, Cherenkov radiation of longitudinal waves, and scattering and surface waves in finite sized plasmas. The discussion progresses from a simple binary model for the emission and absorption to a discussion of collective effects. The external magnetic field is examined and cyclotron phenomena are investigated, first on the basis of the single particle model and, then, in the presence of collective effects. The problem of scattering of transverse electromagnetic waves by the fluctuating charges of the plasma is discussed. A chapter on experimental techniques is included. (M.H.R.)

25156 PLASMA ACCELERATOR HAVING RAPIDLY PULSED COIL FOR EXPELLING PLASMA. Phillips, James A.; Mather, Joseph W. (to U. S. Atomic Energy Commission). U. S. Patent 3,321,664. May 23, 1967.

A method is described for forming a hard vacuum between two concentric coils, introducing an ionizable gas in the space under hard vacuum between two concentric coils, energizing the coils by passing current in the same direction through each of the coils, the current in each of the coils being supplied by an independent power supply, each power supply having identical ringing frequencies, and triggering the resulting magnetic field into an unbalanced configuration by passing a current through a third coil placed between the concentric coils at one end thereof. (AEC)

Production of Plasma

25157 (JINR-P09-3184) K TEORII LINEINOGO INDUKTSIONNOGO USKORITELYA. (To the Theory of Linear Induction Accelerator). Matora, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1967. 13p. (In Russian). Dep. mn.

A differential equation, analogous to the Biot-Savart Law for calculation of an eddy electric field and a relativistic generalization of an equation for paraxial electron trajectories in a strong axially-symmetric electric field are given. Other formulas, necessary for calculation of a linear induction accelerator, are given. A possibility of heavy charge acceleration in a linear induction accelerator is discussed. (auth)

25158 (WERL-3472-5) HIGH TEMPERATURE PLASMAS BY LASER HEATING. Final Report for the Period February 1, 1966–January 31, 1967. Engelhardt, A. G. (Westinghouse Research Labs., Pittsburgh, Pa.). Mar. 27, 1967. Contract AT(30-1)-3472. 50p. Dep. CFSTI.

A summary is presented of the work done in the past year at the Westinghouse Research Laboratories on plasma production by high-power Q-switched lasers. A 70-GHz microwave interferometer has been used to measure electron temperature and density at times after one μsec in plasmas produced from microgram aluminum and mylar ($C_{10}H_8O_4$) disks, and LiH chunks. Framing camera pictures were taken up to a time of 0.3 μsec. An unsuccessful attempt was made to determine by neutron-detection technique the temperature of a plasma containing thermonuclear ingredients. A description is given of the perfection and operation of an electromagnetically retracted pedestal which furnishes a single solid target in vacuo for laser irradiation. A proposed experiment to measure plasma density and temperature by Thomson scattering is discussed. (auth)

25159 VARIOUS REGIMES OF AN ELECTRIC DISCHARGE OF THE PENNING TYPE AT VERY LOW PRESSURES. Boutry, Georges-Albert; Lebon, Pierre (Conservatoire National des Arts et Metiers, Paris. Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). Compt. Rend., Ser. B, 264: 519-22(Feb. 13, 1967). (In French).

The properties of an electric discharge of the Penning type were studied at pressures between 5×10^{-5} and 5×10^{-6} mm of Hg and the existence of two stable regions of the discharge was shown. (tr-auth)

25160 PLASMA TEMPERATURES GENERATED BY FOCUSED LASER GIANT PULSES. Gregg, David W.; Thomas, Scott J. (Univ. of California, Livermore). Contract W-7405-eng-48. J. Appl. Phys., 38: 1729-31(Mar. 15, 1967). (UCRL-70135).

Plasma temperatures generated by focusing ruby-laser giant pulses on surfaces of Be, Al, and Pb in a vacuum were measured as a function of time and giant-pulse intensity. The monochromatic emission intensities of the plasmas (relative to those obtained with a standard source) were measured at wavelengths ranging from 4000 to 10,500 Å, and the temperatures were then calculated from the Planck function. It was found that the plasma temperatures achieved with the lighter elements were hotter and had greater rates of increase with laser intensity. However, the rates of increase were proportional to only the 0.5 power of the laser intensity or less, and the difference in temperatures between target materials was not very great. Temperatures as high as 8×10^5°K were achieved with beryllium. (auth)

25161 DEMONSTRATION OF THE DEIONIZATION OF A MERCURY PLASMA. Baibulatov, F. Kh. (Novosibirsk State Univ., USSR). Usp. Fiz. Nauk, 89: 305-6(June 1966). (In Russian).

The concentration of charged particles in a plasma is regulated by the rate of formation of ion-electron pairs as compared to the rate of disappearance of the pairs due to mutual neutralization. The formation of new pairs ceases on cutting off the ionizing field. The time of existence of an ion-electron gas can be estimated by measuring the current between two electrodes under a slight potential in the plasma. To demonstrate this phenomenon, a high-frequency pulse discharge was excited in an ordinary mercury lamp, and the time for passage of current in the plasma between two electrodes was measured by an oscilloscope. This time turned out to be much greater than the time of excitation of the high-frequency, ionizing field. With a scan of 50 μsec an ionizing field with a damping period of about 1.5 μsec and a total duration of 12 to 15 μsec was observed. (TTT)

Stability of Plasma

Refer also to abstract 25154.

25162 (CEA-R-3156) STABILITE ELECTROSTATIQUE DES PLASMAS DE LON GUEUR FINIE. THEORIE GENERALE. (Electrostatic Stability of Plasmas of Finite Length. General Theory). Cotsaftis, Michel (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb. 1967. 52p. (In French). (EUR-3244.f; EUR-CEA-FC-371). Dep.

With the simple model of a plane geometry, taking into account the finite extension of the plasma along the magnetic field and the existence of a cold plasma between the hot plasma and exterior conducting plates, as well as the reflection of the particles at the mirrors, the curvature of field lines and the density gradient, the equation for electrostatic perturbations, supposing $\beta \ll 1$, is given with the most general particle equilibrium state. This equation is solved. It contains new terms related to the mirror effect, having poles for all the linear combination with integer numbers of the various frequencies of the system for each species of particles. It no longer admits, as previously, a "free wave" solution. Furthermore, the general dispersion relation is given, applying the boundaries conditions, from which the electrostatic stability of the system can be studied. This will be done elsewhere, but some properties of open systems are indicated. (auth)

25163 (EUR-CEA-FC-392) STABILITE ELECTROSTATIQUE DES PLASMAS DE LONGUEUR FINIE. IV. (Electrostatic Stability of Plasmas of Finite Length. IV). Cotsaftis, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug. 1966. 26p. (In French). Dep.

In view of a coherent study of the finiteness effects along the magnetic field of a open-ended system, the very simple case of a double-stream system interacting inside a slab medium filled with a cold plasma is considered, limited by two infinite metallic plates perpendicular to the field lines. The particles of each stream, within the fluid approximation, are supposed to rebound on the two plates which are characterized by three coefficients R, S, μ. The method consisted in writing the general solution of the system of equations and verifying the boundary conditions one has posed on the two plates. (M.O.W.)

25164 (EUR-CEA-FC-404) STABILITE ELECTROSTATIQUE DES PLASMAS DE LONGUEUR FINIE. V. (Electrostatic Stability of Plasmas of Finite Length. V.). Cotsaftis, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug. 1966. 31p. (In French). Dep.

To study in a coherent way finiteness effects along the magnetic lines of an open configuration, the very simple case of a monoenergetic beam flowing through a cool plasma bounded by two infinite metallic plates perpendicular to the magnetic lines is given. The method consists of writing the general solution of the system of equations of the problem and to satisfy the boundary conditions on the two plates supposed to be at the ground potential. (M.O.W.)

25165 (NASA-TN-D-3880) PLASMA STABILITY AND THE BOHR–VAN LEEUWEN THEOREM. Roth, J. Reece (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1967. 54p. CFSTI.

The characteristics of collisionless, nonrelativistic, magnetically confined plasmas possessing minimum reservoirs of free energy are examined. It is anticipated that such plasmas will be subject to the smallest possible number of instabilities. Postulating a condition of Local Classical Kinetic Equilibrium (LCKE) permits the Bohr–van Leeuwen theorem, familiar in classical solid-state physics, to be applied to the interior region of magnetically confined plasmas. This theorem states that an element of plasma in the interior of such confined plasmas should possess zero net diamagnetism, hence, zero net current transverse to the applied magnetic field. The characteristics of the plasma and magnetic field needed to achieve this result are examined, and a set of sufficient conditions for vanishing transverse current is obtained that is consistent with the minimization of free energy within the plasma element. The most restrictive of these conditions is that the transverse energy density $nmv_\perp^2/2$ not vary in a direction transverse to the magnetic field lines. Although this condition may be met in the interior of plasmas, it cannot be met in the sheath region of finite laboratory plasmas. The deduced characteristics of LCKE plasmas with minimum free energy are compared with results reported in the experimental literature. Examples are found in which the observed charistics conform to those predicted. In particular, cases are cited in which the observed plasma diamagnetism is less than would ordinarily be expected. Other cases are cited in which the transverse energy density profile remains nearly constant across the plasma interior. Such data are not extensive enough to be considered conclusive, but they do provide support for the viewpoint that any plasma confined for even a short time will approach a minimum-free-energy, LCKE condition in its interior. A conceptual design is presented of a plasma injection and confinement system, which is aimed at maintaining a condition of minimum free energy during and after plasma buildup. The system consists of a "bumpy torus" confinement geometry together with a suitably modified Penning discharge plasma injection scheme. Experimental results obtained with such a Penning discharge injection scheme are used to show its capabilities for generating an approximately Maxwellian and isotropic plasma within the confinement geometry. (auth)

25166 (TID-23813) VELOCITY SPACE INSTABILITIES IN A TOROIDAL GEOMETRY. Berk, H. L.; Galeev, A. A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov. 1966. 41p. (IC-66/91(Rev.)). Dep. CFSTI.

A self-consistent equilibrium is derived for a simple toroidal model from knowledge of the particle orbits. This equilibrium is investigated for velocity space instabilities analogous to the loss cone of mirror machines. An ion instability generated by particles in "trapped" or nearly "trapped" orbits is found when the rotational transform is relatively weak, but is stabilized with larger rotational transform. Instability is also found at the plasma edge due to a loss of particles in a preferred region of velocity space. A qualitative discussion of the quasi-linear development of these instabilities is presented. (auth)

25167 LOW-FREQUENCY LOSS-CONE INSTABILITIES OF PLASMA IN TAYLOR MINIMUM-B CONFIGURATIONS. Saison, R.; Wimmel, H. K. (Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch., 22a: 281-2(Feb. 1967).

It was recently shown that electrostatic low-frequency loss-cone instabilities of collisionless low-β plasma in Taylor minimum-B configurations with $\epsilon R_{i,e} \ll 1$ ($\epsilon = d \ln B/dx$, $R_{i,e}$ = gyroradii) can occur. These instabilities are unstable drift waves with $Re\omega \sim k_\perp \nu_B (\nu_B = \epsilon v_\perp^2/2\Omega)$. The occurrence of these instabilities is consistent with a stabilization theorem by Taylor, since magnetic moment

is not conserved. On the other hand, a stabilization theorem published by Rosenbluth and Kroll is refuted by the existence of the new instabilities. The dispersion relation for these instabilities was solved previously, assuming both $|k_\perp v_B|$ and $|\mathrm{Re}\omega| \ll |k_z v_z| \ll |\mathrm{Im}\omega| \ll \Omega_i = eB/m_i c$. In the present note, the assumptions made are much less restrictive, viz. merely $|k_\perp v_B|$ and $|k_z v_z| \ll |\omega| \ll \Omega_i$. Two different necessary and sufficient instability conditions are also discussed. The new calculations give a more general expression for the growth rate, while the stability limit and the expression for $\mathrm{Re}\omega$ that were obtained earlier still apply in the present, more general case. (W.D.M.)

25168 SHEAR STABILIZATION OF A POTASSIUM PLASMA. Chen, Francis F.; Mosher, David (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Rev. Lett., 18: 639-41(Apr. 17, 1967).

Applying shear to the magnetic field confining a thermally ionized potassium plasma reduces the escape rate by as much as a factor of 30. This effect is accompanied by both a reduction and a localization of the low-frequency oscillations. (auth)

25169 DIFFUSION OF A COLLISIONLESS POTASSIUM PLASMA ACROSS A MAGNETIC FIELD DURING DRIFT INSTABILITY. Ivanov, A. A.; Rakhimbabaev, Ya. R.; Rusanov, V. D. Zh. Eksp. Teor. Fiz., 52: 833-6(1967). (In Russian).

A method for determining the transverse diffusion coefficient of a collisionless plasma is proposed, based on measurement of the longitudinal flux of the plasma. Experiments performed on an installation of the Q-machine type showed that drift oscillations result in anomalous escape of the plasma from the system. The diffusion coefficient decreases as 1/H with increase of the magnetic field strength and in order of magnitude is the same as the Bohm value. (auth)

25170 INVESTIGATION OF THE TURBULENT STATE OF A PLASMA DURING DRIFT INSTABILITY. Buchel'nikova, N. S.; Salimov, R. A.; Eidel'man, Yu. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz., 52: 837-48(1967). (In Russian).

The plasma state and diffusion during drift instability in a potassium plasma are investigated for large oscillation amplitudes: $\tilde{n}/n \sim 1$. The plasma is found to be turbulent, but complete randomization of the oscillation phases is not observed. The time of maintenance of phase correlation is of the order of ~10 oscillation periods. The diffusion coefficient grows with growth of the oscillation amplitude and reaches $D \sim 10^3$ cm^2/ sec for $\tilde{n}/n \sim 1$ and H ~ 1000 Oe which exceeds the classical coefficient by three orders of magnitude. (auth)

Shielding

Refer also to abstracts 24891, 25397, and 25479.

25171 (UCID-15133) NOTES ON MONTE CARLO METHOD FOR NON-LINEAR RADIATION TRANSPORT IN GENERAL AND ON THE INDIGO CODE IN PARTICULAR. Nelson, Robert (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 12, 1967. Contract W-7405-eng-48. 13p. Dep. CFSTI.

A Monte Carlo code, INDIGO, designed to solve one-dimensional nonlinear radiation transport problems in real materials is described. The code works best in systems which are far from thermal equilibrium and which have extreme variations in cross sections over the ranges of interest in space or photon energy. It is handicapped in systems with extremely large absorption cross section, i.e., in systems where the mean free path for photons is very small compared to the space mesh, and in systems that are in thermal equilibrium. (S.F.L.)

Solid-State Physics

Refer also to abstracts 24034, 24273, 24773, 24806, 24807, 25413, and 25474.

25172 (BNL-11281) SPIN WAVE INELASTIC SCATTERING ON MAGNETIC METALS. Nathans, R. (Brookhaven National Lab., Upton, N. Y.). [1966]. Contract AT-30-2-GEN-16. 27p. (CONF-670206-3). Dep. CFSTI.

From 96th Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Los Angeles, Calif.

A brief discussion of the broad aspects of neutron scattering in magnetic materials is followed by a review of specific techniques used by various investigators for study of spin waves. Some experimental results are presented, and possible interpretations of results obtained to date are considered. Areas in which further work is needed are pointed out. (A.G.W.)

25173 (ANL-Trans-446) DEFECT STRUCTURES AT HIGH FRENKEL DEFECT DENSITIES. Lueck, G.; Sizmann, R. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Phys. Status Solidi, 6: 263-72(1964). 16p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

The rate of production of Frenkel defects during irradiation is diminished by the spontaneous recombination of vacancies and interstitial atoms that lie close together (radiation annealing). Investigations of a detailed model of this type give dose curves and the distribution of production rates. A tendency is found for an accumulation of defects of the same kind, and this leads, for high defect densities, to characteristic defect structures. Consequences of this behavior are discussed, especially with regard to the recovery kinetics. (auth)

25174 ISOMER SHIFT OF ^{57}Fe IN TRANSITION METALS UNDER PRESSURE. Ingalls, R.; Drickamer, H. G.; De Pasquali, G. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. Phys. Rev., 155: 165-70(Mar. 10, 1967). (COO-1198-389).

Isomer shifts of ^{57}Fe in several transition metals were measured as a function of pressure up to nearly 300 kbar. The host metals studied were Cr, Co, Ni, Nb, Mo, Pd, Ta, W, Pt, and Au. The data are discussed in terms of the volume dependence of the density at the nucleus from 4s-like conduction electrons and the density of the nucleus from 3s core electrons which are shielded by the 3d-like conduction electrons. The results of the previous paper regarding amount of 4s character, n_s, and amount of 3d character, n_d, on the iron impurity atom, are used. The data are shown to be consistent with n_s decreasing or n_d increasing, or both, as one goes through each transition-metal series toward more d electrons of the host, and n_s decreasing or n_d increasing, or both, as pressure is applied to the host metal. The degree of the second effect is shown to be related to the calibration constant of the isomer shift. (auth)

25175 PULSED NUCLEAR MAGNETIC RESONANCE IN ROTATING SOLIDS. Kessemeier, H.; Norberg, R. E. (Washington Univ., St. Louis). Phys. Rev., 155: 321-37(Mar. 10, 1967).

Pulsed nuclear-magnetic-resonance measurements have been made on rapidly rotating solid samples. Transient induction signals were observed for ^{31}P and ^{27}Al nuclei in Mg_3P_2, Zn_3P_2, and AlP powders. A stochastic theory of relaxation is used to discuss the transverse and longitudinal spin relaxation processes. Indirect nuclear exchange appears to limit the relaxation times T_1 and T_2 at high rotation rates. (auth)

25176 ANALYSIS OF Sb-IMPLANTED SILICON BY (p,p) SCATTERING AND HALL MEASUREMENTS. Eriksson, L. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Davies, J. A.; Denhartog, J.; Mayer, J. W.; Marsh, O. J.; Markarious, R. Appl. Phys. Lett., 10: 323-5(June 1, 1967).

The annealing behavior of Si crystals, implanted with ~10^{15} Sb ions/cm^2 at 40 keV, has been studied by observing the orientation dependence of the scattering yield of 1.0-MeV protons and also by electrical measurements. The scattering measurements provide information on the sites of the implanted atoms and on the extent of lattice disorder. After a room temperature implant, the lattice is heavily damaged, with the Sb occupying random (or interstitial) positions. After annealing at 650°C, ~75% of the Sb is substitutional with very little damage remaining. Comparable results are obtained in a 400°C implant. (auth)

25177 RADIOLUMINESCENCE OF NaCl SINGLE CRYSTALS. Plachenov, B. T.; Avdonin, V. P.; Glinin, V. P.; Kapishevskii, V.; Mikhalchenko, G. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 188-91(Sept. 1966).

Translated from Opt. Spektros., 21: 332-9(Sept. 1966).

The results of a study of the spectra and radioluminescence yields of NaCl crystals in the temperature interval from 83° to 540°K are presented. Also examined is the accumulation of charge carriers in the crystal when it is exposed to beta particles and the influence of this accumulation on the radioluminescence yield. (auth)

25178 EFFECT OF IONIZING RADIATION ON THE FORMATION OF COLOR CENTERS AND ON THE PHOTOLUMINESCENCE OF THE NaF:U CRYSTALLINE PHOSPHOR. Alybakov, A. A.; Gubanova, V. A.; Shamyrkanov, Y.; Ustinova, N. D. Opt. Spectros. (USSR) (Engl. Transl.), 21: 222-3(Sept. 1966).

Translated from Opt. Spektros., 21: 395-6(Sept. 1966).

When crystals of NaF : U were irradiated by x rays and ^{60}Co γ rays, F, R, and M color centers were formed. As the U concentration increased, the height of the maxima of the F, R, and M absorption bands decreased; in crystals with high U concentration, R centers were not formed at all. The luminescence spectrum of NaF : U crystals irradiated with γ rays and exposed to ultraviolet radiation was studied. As the radiation dosage increased, the intensity of luminescence decreased. The change in intensity of luminescence depended strongly on U concentra-

tion. Possible explanations of the observed results are considered briefly. (A.G.W.)

25179 THE HYPERFINE STRUCTURE OF BiH AND BiD BANDS. Neuhaus, Hinrek (Univ. of Stockholm). Z. Naturforsch., 21a: 2113-14(Dec. 1966). (In German).

The hyperfine structure of the (0–0), B(0) → A(1) bands of BiH and BiD was measured. The results are tabulated. (J.S.R.)

25180 A STUDY OF THE RADIATIONAL ACCUMULATION OF F AND M CENTERS USING A STATISTICAL TEST METHOD. Melik-Gaikazyan, I. Ya.; Kravets, A. N.; Vaisburd, D. I. Opt. Spectros. (USSR) (Engl. Transl.), 21: 140-1(Aug. 1966).

Translated from Opt. Spektros., 21: 241-2(Aug. 1966).

A statistical experiment on a two-dimensional lattice containing $N = 10^4$ units was carried out to test previously obtained equations for radiational accumulation of F and M centers in crystals. The experiment was performed by throwing points in a lattice. The coordinates of the points were selected from a table of random numbers. Four series of tests were carried out with 3000 throws in each series. Results agreed well with the equation for accumulation of F centers. Results for the accumulation of M centers diverged from the equation above 1000 throws. (A.G.W.)

25181 ON THE FORMATION OF THE H′ CENTER. Izmailov, S. V.; Rozman, G. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 104-5(Aug. 1966).

Translated from Opt. Spektros., 21: 178-80(Aug. 1966).

The feasibility of forming a composite defect, the H′ center, by the trapping of an electron by a neutral pair of vacancies, a dipolon, is investigated. An explicit expression is given for the recombination coefficient. The model of the H′ center is used for explaining variations in the absorption spectrum of irradiated alkali metal halide crystals. (auth)

25182 LUMINESCENCE OF BOUND EXCITONS IN ALKALI-HALIDE CRYSTALS WITH FIRST-GROUP CATION IMPURITIES. Valbis, Ya. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 106-9 (Aug. 1966).

Translated from Opt. Spektros., 21: 181-7(Aug. 1966).

The photo- and x-ray luminescence of KBr and KI crystals with small amounts of other alkali metals (Li^+, Na^+, Rb^+, Cs^+) added as impurities is studied. Supplementary bands of luminescence observed at low temperatures are ascribed to radiation from excitons localized near the impurity cations. The possibility of exciting such luminescence in a recombination process is shown. (auth)

25183 SLOW NEUTRON SCATTERING IN CRYSTALS AND LIQUIDS. Kosaly, Gyorgy; Solt, Gyorgy (Central Research Inst. for Physics, Budapest). Magyar Fiz. Foly., 14: 571-93(1966). (In Hungarian).

Like the x rays for structure determinations, the thermal and cold or slow neutrons are well suited for the microdynamic study of condensed matter. Therefore, the best method to obtain information on the internal dynamics of matter by means of scattering experiments was studied. The results were compared with data obtained by other methods, such as visible-light scattering, infrared spectroscopy, Mössbauer effect, etc. Bravais-type cubic crystals were considered because they include a large number of metals. In addition to the study of crystals, incoherent scattering phenomena in liquids were also investigated. It was found that the chief advantage of the neutron scattering method lies in the fact that cold and slow neutrons cover a broad Q range, of special interest for atom dynamics. Methods based on infrared and Raman spectra are better for studying scattering by ideal gas molecules; neutron spectroscopy is preferred for the study of large molecules and for molecules bound in crystals. (TTT)

25184 RADIOLUMINESCENCE FLASH IN NaCl CRYSTAL. Plachenov, B. T.; Avdonin, V. P.; Glinin, V. P.; Kapishevskii, V.; Mikhalchenko, G. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 258-60(Oct. 1966).

Translated from Opt. Spektros., 21: 460-5(Oct. 1966).

The conditions for stimulation of low-temperature luminescent flashes in single crystals of NaCl previously excited by beta radiation are discussed, as well as the possible mechanism of this effect. Apparently the emergence of the flashes depends on the accumulation of holes at luminescence centers. Conclusions are drawn about the recombination nature of both the flashes and the steady-state radioluminescence in the NaCl crystal. (auth)

25185 RADIOLUMINESCENCE FLASH IN NaCl:Ag CRYSTAL. Plachenov, B. T.; Avdonin, V. P.; Mikhalchenko, G. A.; Smagin, V. M. Opt. Spectros. (USSR) (Engl. Transl.), 21: 381-3(Dec. 1966).

Translated from Opt. Spektros., 21: 693-6(Dec. 1966).

The temperature conditions giving rise to flashes of radioluminescence in NaCl(Ag) crystals with different activator concentrations have been investigated. Comparison of the results obtained with the thermoluminescence and the spectral characteristics of the radioluminescence of these crystals confirms the presence of electron and hole recombination luminescence in them. (auth)

25186 THE ROLE OF VARIOUS ELECTRONIC EXCITATIONS IN THE RADIATION COLORATION OF IONIC CRYSTALS. Lushchik, Ch. B.; Vale, G. K.; Ilmas, E. R.; Rooze, N. S.; Elango, A. A.; Elango, M. A. Opt. Spectros. (USSR) (Engl. Transl.), 21: 377-80(Dec. 1966).

Translated from Opt. Spektros., 21: 686-92(Dec. 1966).

The formation of F centers in NaCl·Tl crystals acted on by uv radiation with photon energies from 4 to 21.2 eV was studied. The F centers are generated by the ionization of Tl^+ centers and by the formation of excitons and electron–hole pairs. The efficiency of F-center generation by 21.2-eV photons is markedly greater because of the production of two electron–hole pairs by a single photon. The curves representing the increase in the number of F centers upon irradiation with uv rays consist of two stages. Both stages are to a large extent frozen at temperatures that guarantee hole localization. The second (linear) stage is also exhibited by thin filamentary (apparently dislocation-free) crystals. A hypothesis about the generation of F centers as a result of interaction between electron–hole pairs and vacancy complexes (first stage) and as a result of the meeting of two holes at neighboring halide ions in regular, defect-free portions of the lattice (second stage) is examined. (auth)

25187 ADSORPTION OF SILICON ON TUNGSTEN SINGLE-CRYSTAL SURFACES IN THE FIELD ELECTRON MICROSCOPE. Neumann, H. (Univ., Leipzig). Z. Naturforsch., 21a: 2122-4 (Dec. 1966). (In German).

A method for the utilization of the field electron microscope for the determination of desorption energies of individual single crystal surfaces is described. The desorption energy of Si from different W single crystal surfaces was determined. The current variations during the desorption process was measured as a function of time and of temperature for the (111), (116), and (113) surfaces. The Levine and Gyftopoloulos equations were used to calculate the desorption energies of the W crystal surfaces. The results agree with experimental values. (J.S.R.)

25188 X AND GAMMA RADIATION IN TECHNOLOGY AND MEDICINE. Regler, Fritz (Technische Hochschule, Vienna). Elektrotech. Maschinenbau, 83: 529-41(Oct. 1966). (In German).

The progress made by extension of the x-ray range into the area of extremely long and short wavelengths is discussed. Studies that have been made in the long wavelength range, x-ray spectral analysis, the microprobe, absorption of x radiations, spectroscopy of extremely short wavelength x radiations, absorption coefficients of high-energy x rays, use of high-energy x rays and γ radiation in technology and medicine, radioactive isotopes, and modern methods for use of conventional x radiation are discussed. While the extremely long-wavelength x radiations are important in basic research in the area of solid-state physics, high-energy x rays are valuable in materials testing. However, the laws that govern them differ somewhat from those for classical x radiation. Advances in the area of electro-optics are important for construction of image intensifiers. (BBB)

25189 STRESS AND DILATATION FIELDS OF THE ⟨111⟩ DISLOCATION IN CUBIC CRYSTALS. Chou, Y. T. (United States Steel Corp., Monroeville, Pa.); Mitchell, T. E. J. App. Phys., 38: 1535-40(Mar. 15, 1967).

Exact expressions of the stress components and dilatation of a straight dislocation, lying in a ⟨111⟩ direction in a cubic crystal, were obtained analytically. The transitions in the contours of stress and dilatation fields were found to be controlled by an elastic anisotropy parameter R. For bcc crystals, the transition of σ_{33} contours of a screw dislocation takes place at $R = (\frac{3}{2})^{\frac{1}{2}}$ and that of σ_{13} contours at $R = 3$ (for W, Ta, V, Cr, Mo, Nb, and Fe, $R < (\frac{3}{2})^{\frac{1}{2}}$; for Na, K, Li, $(\frac{3}{2})^{\frac{1}{2}} < R < 3$). The results of the stress analysis are useful in treating the dissociation of screw dislocations in the bcc lattice. The dilatation contours of a [111] dislocation of the mixed type with Burgers vector a/2[111] are illustrated. The differences in shape of the contours for the anisotropic and isotropic cases are greater for the pure edge dislocation than for the mixed-type dislocation. (auth)

25190 COMMENTS ON THE IDENTIFICATION OF VACANCY AND INTERSTITIAL CLUSTERS IN NEUTRON-IRRADIATED NICKEL. Eyre, B. L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Appl. Phys., 38: 1973(Mar. 15, 1967).

In a recent note Brimhall et al., (J. Applied Phys., 37: 3317 (1966)) reported some direct observations of point defect clusters in nickel, neutron irradiated to a dose of 2.5×10^{18} n/cm^2 (E ~

1 MeV) at 40°C. It was claimed that both vacancy- and interstitial-type clusters were positively identified. It is shown that the results presented by Brimhall et al., are not sufficient for the nature of the clusters to be analyzed unambiguously, and an alternative interpretation of the visible damage structure is suggested which is consistent with the results. (W.D.M.)

25191 RADIATION DAMAGE IN CADMIUM SULFIDE AND CADMIUM TELLURIDE. Chester, R. O. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Appl. Phys., 38: 1745-52(Mar. 15, 1967). (ORNL-P-1800).

The effects of irradiation with 1.17- and 1.33-MeV ^{60}Co γ rays, 0.662-MeV ^{137}Cs γ rays, and thermal neutrons on the carrier concentration in n-type CdS and CdTe were studied by means of Hall-effect measurements. Irradiation of these materials at room temperature did not introduce any new energy levels in the range from 0.02 to 0.2 eV below the conduction band (the range accessible by experiment), although the density of levels initially present in this interval was altered and, under certain conditions, deep-lying acceptor states were produced. The most significant observation was the change in the nature of the effect as the energy of the incident gamma rays was changed. For example, ^{137}Cs photons introduce acceptors in CdS and donors in CdTe, while ^{60}Co photons produce the inverse effect. Atomic displacement calculations indicate that the lower-energy ^{137}Cs photons should preferentially displace sulfur atoms in CdS and cadmium atoms in CdTe; the opposite is calculated for ^{60}Co. Hence, these studies suggest that the net result of displacement of a chalcogenide atom is acceptor introduction, with donor introduction resulting from displacement of the cadmium atom. Thermal neutron irradiation of both materials introduces acceptors. (auth)

25192 SCATTERING OF POLARIZED NEUTRONS BY MAGNETIC COMPOUNDS WITH A NON-COLLINEAR STRUCTURE. Sivardiere, J. (CEN, Grenoble, France). Solid State Commun., 5: 289-92(Apr. 1967). (In French).

Evidence is given for a polarization-dependent magnetic cross-section term and change in polarization of thermal neutrons. The results are applied to helimagnetic structures. Experimental work with $TbFeO_3$ is mentioned. (auth)

25193 ELECTRON PARAMAGNETIC RESONANCE STUDIES OF ELECTRON-IRRADIATED LITHIUM SULFATE AT LIQUID NITROGEN TEMPERATURE. Aseltine, Clifford L.; Kim, Y. W. (Wayne State Univ., Detroit). Contract AT(11-1)-1054. J. Phys. Chem. Solids, 28: 867-73(May 1967). (COO-1054-22).

Single crystals of $Li_2SO_4 \cdot H_2O$ were grown with labeled Li and H isotopes near room temperature, and irradiated in 1-MeV electron beams near 77°K. EPR studies of the irradiated samples were conducted near 77°K, without warming the samples. The anisotropic spectra with resolved proton (or deuteron) hyperfine structure are satisfactorily described in terms of a spin Hamiltonian consisting of a Zeeman term and a proton (or deuteron) hyperfine interaction term, where both the g-tensor and the hyperfine tensor are axially symmetric. The Li-hyperfine interaction is not needed to describe the observed anisotropy, and its only noticeable effect is on the width of individual hyperfine lines. The defect of axial symmetry responsible for the spectra is probably an OH radical with insignificant bonding to its neighbor. If Ziegler's crystallographic data are taken to be correct, the defect is oriented very closely to the direction of O_5-O_4. (auth)

25194 ANHARMONIC VIBRATION IN FLUORITE STRUCTURES. Dawson, B.; Hurley, A. C.; Maslen, V. W. (Commonwealth Scientific and Industrial Research Organization, Melbourne). Proc. Roy. Soc. (London), Ser. A, 298: 289-306(May 2, 1967).

High-temperature neutron-diffraction measurements on UO_2 and CaF_2 made recently by Willis are examined by means of the generalized formulation of the structure factor that recognizes the antisymmetric properties of atoms occupying noncentrosymmetric lattice sites. Numerical analysis of the neutron data in terms of an anharmonic vibration formalism developed for effective one-particle potential fields of the type $V_j(r) = V_{c,j} + \frac{1}{2}\alpha_j(x^2 + y^2 + z^2) + \beta_j xyz$ + quartic terms shows that certain unusual features of the observations are readily accounted for by the antisymmetric (β) components associated with the tetrahedral point symmetry of the anionic sites. Values are derived for the α_j and β_j parameters in both UO_2 and CaF_2, and their ability to reproduce the experimental observations over a wide range of elevated temperature is demonstrated. The parameters derived for CaF_2 are compared with theoretical estimates obtained from an Einstein-type model of the vibrating lattice, using the various expressions for the interionic interaction in fluorite that were proposed by Benson and Dempsey. Despite evident limitations in this model, it is possible to conclude that the Pauling radii for Ca^{2+} and F^- cannot reproduce the physical behaviour of this system. (auth)

25195 STRENGTH OF THE s-f EXCHANGE INTERACTION IN RARE EARTH INTERMETALLICS. Barnes, R. G. (Ames Lab., Iowa); Jones, E. D. Contract W-7405-eng-82. Solid State Commun., 5: 285-7(Apr. 1967). (IS-1517).

Recently determined values of the temperature-independent isotropic Knight shift in the nonmagnetic rare earth dialuminides, YAl_2, $LaAl_2$, and $LuAl_2$, indicate that previous estimates of the s-f exchange interaction-parameter J_{sf} in the RAl_2 series (R = rare earth) should be increased approximately 2.5 times. The new J_{sf} values are in good agreement with those obtained in similar fashion for the rare earth phosphides and arsenides. These results reaffirm the usefulness of the uniform polarization model as a description of magnetic interactions in rare earth intermetallics. (auth)

25196 ISOTOPIC DIFFERENCES IN THE KNIGHT SHIFT. Dolgopolov, D. G.; Zhogolev, D. A. (Physico-Technical Inst. of Low Temperatures, Kiev). Fiz. Metal. Metalloved., 23: 23-7 (Jan. 1967). (In Russian).

The difference in Knight shifts for two isotopes of the same metal was estimated as a function of the following factors: difference in lattice constants; electron-phonon interaction; and difference in magnetic moments of the nuclei. The change in the Knight shift due to changes in the lattice constant was determined from the premise that the Knight shift is roughly proportional to the paramagnetic susceptibility of electron gas. The effect of electron-phonon interaction was considered with the aid of methods of the quantum field theory. And the effect of differing magnetic moments of the nuclei of the isotopes was considered from the standpoint of their influence on the magnetic interaction between the electron and the nucleus. It is shown that the relative differences in the lattice constants and nuclear magnetic moments of the isotopes are extremely small. As for the effect of electron-phonon interaction on the relative Knight shift k, the available experimental and theoretical findings show that for rubidium (isotopes ^{85}Rb and ^{87}Rb) $k^{85}/k^{87} - 1 = 0.38 \pm 0.03\%$, i.e. Δk is negative; for the lithium isotopes ^6Li and ^7Li $k^6/k^7 - 1$, i.e., again $\Delta k < 0$. The observed negativeness of Δk gives reason to believe that the experimentally recorded isotopic differences in the Knight shift for two isotopes of the same metal are chiefly conditioned by phonon-electron interaction. (ATD)

25197 ELECTRON MICROSCOPY BY SECONDARY EMISSION UNDER ION BOMBARDMENT. III. Fagot, Bernard; Fert, Charles (Faculte des Sciences, Toulouse). J. Microscop., 5: 409-20(1966). (In French).

Studies were conducted with an Ar beam incident upon a crystalline metal surface. The secondary electron emission from the surface was used to form an image, the contrast of which was related to the coefficient of electron emission of the incident surface. The Ar^+ beam used was accelerated by voltages of 50 to 55 kV. Results were obtained on electron secondary emission of monocrystalline targets under ion bombardment, according to the orientation of the incident beam. Also presented are applications of these results in secondary emission electron microscopy, interpretation of emission contrast, and a study of surface states, epitaxial growth, and orientation problems. (BBB)

25198 COLOR CENTERS IN AMMONIUM HALIDES. Vannotti, L.; Zeller, H. R.; Bachmann, K.; Kaenzig, W. (Eidgenoessische Technische Hochschule, Zurich). Phys. Kondens. Mater., 6: 51-94(1967). (In German).

Color centers produced by x rays in ammonium halides at various temperatures between 20°K and room temperature have been investigated by means of paramagnetic resonance and by optical methods. Two kinds of paramagnetic defects were found to be predominant, the self-trapped hole (V_K center) and another electron deficiency center involving a NH_4^+ radical. The electronic structure of the V_K center is the same as in the alkali halides, except that the orientation of the molecular axis is along [100] instead of [110]. The kinetics of the thermally activated motion of the V_K centers and of their recombination with electrons has been studied. The electronic structure of the second center was derived from the hyperfine spectrum of the paramagnetic resonance. The rotation of the NH_4^+ ion and its connection with the order-disorder transition in NH_4Cl has been studied. (auth)

25199 ELECTRON MICROSCOPY BY SECONDARY EMISSION UNDER ION BOMBARDMENT. II. Fagot, Bernard; Fert, Charles (Faculte Des Sciences, Toulouse). J. Microscop., 5: 389-408(1966). (In French).

An electron microscopic technique is described wherein high-resolution contrasts may be observed in crystalline metal objects on account of differences in secondary emission of electrons under ion bombardment. Thus, differences in emission from the incident surface under bombardment by an ion beam of a uniform intensity are the result of differences in the coefficient of secondary emis-

sion, that is, the number of electrons emitted per incident ion. The more emissive the surface, the lighter the image. This study of emission contrast in secondary electron microscopy under ion bombardment was based on the results found in the secondary electron emission with monocrystalline targets. The coefficient of emission was measured on various metallic crystals as a function of the orientation of the incident beam. The results were readily explained by the geometric notion of opacity of a crystalline lattice for various directions. Most of the results were obtained with Ar^+ ions accelerated to energies up to 50 kV. (BBB)

25200 THEORY OF NARROW-ANGLE X-RAY SCATTERING AND ITS MEASUREMENT BY THE MOESSBAUER EFFECT. Champeney, D. C. (Univ. of East Anglia, Norwich, Eng.). Brit. J. Appl. Phys., 18: 549-61(May 1967).

It is shown how the Mössbauer effect may be used to measure the total scattered energy, on an absolute basis, for single scattering by an inhomogeneous medium, and to measure the angular distribution for the case of multiple scattering. The method, which involves moving the scatterer transversely to the gamma-ray beam with speeds of the order of 10 to 10^3 cm sec^{-1}, is interpreted in terms of the Doppler effect and also in terms of the time modulation of photon wave trains. Expressions relating the total scattered intensity in single scattering to the structure of the medium are derived, allowing for interference and particle size distributions by using the Born approximation and also by using the phase-lag approach. Multiple scattering is treated by the phase-lag method, and it is shown that the distinction between diffractive and refractive scattering is unimportant in certain cases. It is shown that the angular distribution in the case of multiple scattering is related simply to the autocorrelation function of the refractive index gradient within the material. (auth)

25201 PROTON SCATTERING MICROSCOPY. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag. (8), 15: 845-54(Apr. 1967). (AERE-R-5372).

The regular nature of the crystal lattice has a marked influence on the spatial distribution of protons elastically scattered from the surface of a single crystal, inasmuch as the close-packed rows and planes of atoms prevent protons emerging in certain well-defined crystallographic directions. This results in the formation of regular patterns, called proton blocking patterns, on a fluorescent screen held parallel to the crystal surface. A technique based on this phenomenon is described, which can be employed at proton energies below 50 keV to study the structures of crystals and thin films, and to examine the effects of radiation damage produced during the ion implantation doping of semiconductors. (auth)

25202 MOESSBAUER SPECTRA IN NONIDEAL CRYSTALS. Kvashnina, L. B.; Krivoglaz, M. A. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved., 23: 3-14(Jan. 1967). (In Russian).

The effect of randomly distributed defects in nonideal crystals on the spectral distribution of the Mössbauer line is investigated. The pattern of this distribution is largely determined by the decrease in perturbation energy with increasing distance to the defect and it differs for different types of defects. Owing to the displacement of the energy terms of Mössbauer nuclei at various distances from the defects, the resulting Mössbauer spectrum gets blurred. Blurred distributions of this kind are considered for several types of defects, chiefly those creating relatively slowly decreasing distortion fields (screw and edge dislocations, dislocation loops, new-phase particles). Estimates of the extent of broadening of the Mössbauer line are presented; it is shown that in strongly deformed crystals this broadening is comparable with the natural width of ^{57}Fe: $\gamma = 4.5 \times 10^{-9}$ eV. The defects present in the neighborhood of a given nucleus influence the electron and spin densities of the nucleus, the force constants, and the gradient of the electrical field, which leads to changes in the isomeric and relativistic displacements of energy levels as well as in Zeeman and quadrupole splitting. (ATD)

25203 ENERGY DISTRIBUTION OF ONE-PHONON NEUTRON SCATTERING IN CRYSTALS. II. ANHARMONISM. Kashcheev, V. N. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 6, 7-13(1966). (In Russian).

The first two moments of the energy distribution of one-phonon coherent neutron scattering in ferrodielectrics due to anharmonicity are derived. The anharmonic contributions to the moments are found to be at least 10 times greater than those of the spin–phonon interaction. (auth)

25204 ATOMIC PARAMETERS AND MAGNETIC STRUCTURE OF $MnUO_4$. Bacmann, M.; Bertaut, E. F. (CEN, Grenoble, France). J. Phys. (Paris), 27: 726-34(Nov.-Dec. 1966). (In French).

$MnUO_4$ crystallizes in space group Imma ($a = 6.64_7$ Å; $b = 6.98_4$ Å; $c = 6.75_8$ Å). The Mn spins are ordered antiferromagnetically below $T_N = 12°K$. The Néel sublattices are (100) planes with alternating + and − spins. Magnetic and crystallographic unit cells coincide. The spin directions along b minimizes the dipolar energy $W = -7.3 \times 10^1$ ergs. The spin value is $S = 2.44$ at 4.2°K. The superexchange at right angles and super-superexchange interactions are compared in $CoUO_4$ and $MnUO_4$. (auth)

25205 MAGNETIC PROPERTIES OF URANIUM TELLURIDES. Chechernikov, V. I.; Pechennikov, A. V.; Barykin, M. E.; Slovyanskikh, V. K.; Yarembash, E. I.; Ellert, G. V. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 52: 854-6(1967). (In Russian).

The magnetic properties of the tellurides UTe, U_3Te_4, U_2Te_3, UTe_2 and UTe_3 were investigated at temperatures between 77 and 600°K and at various magnetic field strengths. The magnetic transformation temperatures were determined for the compounds UTe, U_3Te_4, and U_2Te_3 and are respectively 103, 105, and 122°K. It was also found that in UTe_2 and UTe_3 the paramagnetic Curie point is negative. (auth)

25206 ENERGY DISTRIBUTIONS OF HIGH ENERGY PRIMARY KNOCK-ONS PRODUCED BY FISSION FRAGMENTS. Izui, Kazuhiko (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Jap., 22: 1015-24(Apr. 1967).

The limits of validity of some approximations for the problem of collisions between fission fragments and lattice atoms in aluminum, gold, and uranium were determined on the basis of Bohr's criteria. The Rutherford approximation was found to be valid for the wide range of energies of fission fragments. Numerical calculations were made of the mean free paths of fission fragments for producing high-energy collisions and the energy distributions of high-energy primary collisions. Results for the degradation of energies from the initial values near 100 MeV to ~1 or ~0.1 MeV are presented. (auth)

25207 EFFECTS OF VARIOUS TYPES OF RADIATION ON CERTAIN PROPERTIES OF DIAMONDS. Spitsyn, Vict. I.; Pirogova, G. N. (Inst. of Physical Chemistry, Academy of Sciences, USSR). pp 23-30 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

Diamonds weighing 50 to 250 mg were irradiated with slow neutrons, with a mixture of slow and fast neutrons, with 1-MeV electrons, with ^{60}Co gamma rays, and with 1-MeV x rays. The transparent diamonds turned green on irradiation with slow neutrons, black on irradiation with a mixture of fast and slow neutrons, blue on irradiation with 1-MeV electrons, and greenish-blue on irradiation with ^{60}Co gamma rays. The intensity of the color depended on the radiation dose. The absorption spectra in the ultraviolet and visible regions increased strongly on irradiating with neutrons, electrons, or ^{60}Co gamma rays, and especially with a mixture of fast and slow neutrons. The increase in absorption was directly proportional to the dose. Thermal treatment of the irradiated diamonds gave a change in color and absorption. The absorption decreased as a result of the heating. It is believed that the color centers are Frenkel pairs. Colorless diamonds that showed no microwave absorption before irradiation gave an electron paramagnetic resonance (EPR) signal after irradiation. Diamonds irradiated with a mixture of fast and slow neutrons gave the most complex EPR spectrum. (TTT)

25208 MICROSTRUCTURE OF Mn^{2+} IONS IN NaCl CRYSTALS AND RADIATION EFFECTS ON THE CHANGES OF MICROSTRUCTURE. Shvarts, K. K.; Laizan, V. B.; Vitol, A. Ya. (Inst. of Physics, Academy of Sciences, Latvian SSR). pp 31-8 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

As a result of EPR and luminescent studies of NaCl : Mn crystals as a function of the physical chemical state of the crystals (hardened or crumbled), the concentration of admixtures, and the radiation effects, characteristics of the Mn^{2+} centers are explained. In hardened crystals of NaCl : Mn with luminescent centers, the ions Mn^{2+} replace the cation of the initial substance in the regular lattice unit. The validity of the luminescent center model is illustrated by this. Admixtures of the ions Nb^{3+} and Ca^{2+} cause a strong effect on the distribution of the cation vacancies and increase the number of Mn^{2+} ions in the cubic lattice. In NaCl crystals containing Mn and F the Mn^{2+} ions principally are localized near F^- ions. In the NaCl crystals containing Mn and Cd the kinetics of the decay of the paramagnetic centers is strongly altered by γ radiation. This change is connected with the effective capture of charged carriers by Mn centers. (tr-auth)

25209 ELECTRON-MICROSCOPIC STUDIES OF RADIATION DEFECTS IN LiF AND KCl CRYSTALS. Shvarts, K. K.; Ekmanis, Yu. A. (Inst. of Physics, Academy of Sciences, Latvian SSR). pp. 111-16 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

By electron microscopic investigation of the reactor-irradiated LiF and KCl crystals, macrodefects—positive and negative crystals on the surface—were detected. The dimensions of the largest defect were 3 to 5 mm and the smallest were only 0.1 mm. In KCl crystals macrodefects of large diameter predominated but their density was less than in LiF. In reactor-irradiated LiF crystals with doses of 10^{18} n/cm^2 and larger large colloidal particles of diameter 0.1 to 0.5 mm were detected. The method of thermal etching is suitable for the development of latent radiation damage in irradiated crystals. (tr-auth)

25210 ENERGY OF F-CENTER FORMATION IN LiF CRYSTALS EXCITED BY GAMMA AND REACTOR EXCITATIONS. Shvarts, K. K.; Podyn, A. V.; Baltmugur, K. K. pp 117-24 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

From the analysis of experimental data it is concluded that the energy for the formation of F centers under excitation by γ radiation is less than under excitation by thermal neutrons. This conclusion agrees with the general concept of the increase of elastic energy loss with increase of the mass of the bombarding particles and the specific ionization density dE/dx. The energy for the formation of F centers is increased with increased dose under excitation by γ rays and under excitation by thermal neutrons, α particles, and tritons. Quantitative evaluation of the energy for the formation of F centers under excitation with fast neutrons showed that e in this case is larger than under γ excitation. With increase of the irradiation dose an increase of e was observed. The energy for the formation of F centers under all forms of excitation (γ radiation, thermal neutrons, and fast neutrons) increased in very pure crystals. (tr-auth)

25211 PHOTON MULTIPLICATION IN CRYSTALS AND RADIOLUMINESCENCE. Ilmas, E. R.; Liidya, G. G.; Lushchik, Ch. B.; Soovik, T. A. (Inst. of Physics and Astronomy, Academy of Sciences, Estonian SSR). pp 71-83 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

Detection and detailed investigation of photon multiplication in the optical zone of the spectra made it possible to study two basic mechanisms of radioluminescence of crystals: electron holes and excitons. These mechanisms have characteristic peculiarities and play an important role in the luminescence of crystals under the effects of high-energy particles and quanta. The electron-hole mechanism predominates in the stationary radioluminescence and in scintillation both mechanisms participate usually to a comparable degree. In NaI:Tl the electron-hole mechanism probably predominates. The comparatively large inertia of the electron-hole mechanism appears to be one of the possible reasons for the reduction of the actual scintillation yield from the evaluation made in the present study. (tr-auth)

25212 NON-LINEAR EFFECTS IN MIGRATION OF NON-CONDUCTING AND CONDUCTING ELEMENTARY EXCITATIONS IN A_1B_7 AND A_2B_6 CRYSTALS. Gorbachev, B. N. (Inst. of Physics, Academy of Sciences, Latvian SSR). pp 85-97 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

In ionic crystals of the A_1B_7 type (for example, NaCl), minimum energy is necessary for the creation of nonconducting electron excitations or excitons. In crystals of the A_2B_6 type (ZnS), minimum energy is necessary for the creation of electron-hole pairs. The photoluminescence yields of CsI(Tl), KI(Tl), and NaI(Tl) due to exciton migration to illumination centers (instantaneous component) and due to electron-hole pair migration to illumination centers (slow component) are determined as a function of the excitation intensity. The luminescence due to the exciton mechanism of energy transfer depends linearly on the excitation intensity, while the electron-hole component of the luminescence is a nonlinear function of the excitation intensity for a number of ZnS phosphors containing Ag or Ni as activators. The excitation density in alpha and beta tracks is estimated, and the dependence of the luminescence yield as a function of excitation density can be used to explain the magnitude of the alpha/beta ratio in crystals of various types. (TTT)

25213 TEMPERATURE DEPENDENCE OF X-RAY LUMINESCENCE OF In ACTIVATED ALKALI HALIDE CRYSTALS. Aluker, E. D.; Dobrzhanskii, G. F.; Mezina, I. P. (Inst. of Physics, Academy of Sciences, Latvian SSR. Inst. of Crystallography, Academy of Sciences, USSR). pp 99-106 of Radiatsionnaya Fizika. IV. Ionnye Kristally. Shvarts, K. K. (ed.). Riga, Izdatel'stvo Zinatne, 1966. (In Russian).

In In-activated chlorides and bromides in contrast to thallium phosphors, the low-temperature drop of the activator luminescence is not accompanied by the increase of other luminescence, the intensity of which increases with the increase of the concentration of the activator. The increase of the concentration of the activator decreases the degree of the low-temperature drop of the intensity of the activator luminescence. (tr-auth)

Theoretical Physics

Refer also to abstracts 24869 and 25250.

25214 (ISS-67/1) INTRODUZIONE ALLA FISICA DELLE RADIAZIONI. CAPITOLO V. (Introduction to Radiation Physics. Chapter V.). Amaldi, U. Jr. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Jan. 10, 1967. 79p. (In Italian). Dep.

This issue is devoted to an introduction to relativity and quantum mechanics. Some phenomena, which are not explained in the framework of classical physics, are described and from them the two quoted arguments are developed. An elementary presentation of the uncertainty principle and of the wave and corpuscular nature of radiations is followed by a discussion of the stability and structure of atoms. (auth)

25215 MAGNETIC CHARGE AND GENERAL RELATIVITY. Yan, Tung-mow (Harvard Univ., Cambridge, Mass.). Phys. Rev., 155: 1423-7(Mar. 25, 1967).

The compatibility of the magnetic-charge concept with general relativity is examined, using Schwinger's field theory of magnetic charge and his formulation of the quantized gravitational field. For the case of the combined dynamical system of spin-0 charged fields, the electromagnetic field, and the gravitational field, all consistency tests and relativistic invariance are shown to be satisfied. (auth)

25216 OBSERVATIONS ON THE SHEAR-FREE FLOW OF A GRAVITATING GAS. Truemper, Manfred (Univ., Hamburg). Z. Astrophys., 66: 215-24(1967). (In German).

A gas (or a compressible perfect fluid) subject to gravitational forces is investigated on the basis of Newtonian mechanics and Newtonian theory of gravitation. The new results are: (1) a necessary and sufficient condition to be imposed on the acceleration of a shear-free gas flow to ensure the linearity of the velocity field. (2) the proof that a gravitating gas obeying an equation of state $p = p(\rho)$ has a linear velocity field if the shear is zero, and (3) the exhibition of a perfect analogy between the kinematics of the velocity field in Newton and Einstein (general relativistic) mechanics. The results are compared with some statements of general relativity and their relevance for Newtonian and Einsteinian cosmology is discussed. (auth)

25217 CLASSICAL CHARGED PARTICLES. Nisbet, A. (North Carolina State Univ., Raleigh). Ann. Phys. (N. Y.), 42: 173-80(Mar. 1967).

The Dirac equations of motion (in the framework of special relativity) and the momentum law for a system of classical (nonquantum) charged particles interacting with each other and with an incident electromagnetic field are reviewed for closed and open systems, and presented in a manner which leads to an action principle which is free of divergent integrals and in which all interactions are mediated by fields; no direct (action-at-a-distance) interaction between pairs of charges is required. (auth)

25218 INTRODUCTION TO TENSOR CALCULUS AND RELATIVITY. (METHUEN'S MONOGRAPHS ON PHYSICAL SUBJECTS). Lawden, Derek F. New York, Barnes and Noble, Inc., 1967. 196p. $2.85 paper; $4.50 cloth.

After a discussion of the special relativity principle and its relation to Newton's laws and Maxwell's equations, Cartesian tensors are introduced. Tensors are employed systematically to develop the special theory in a four-dimensional pseudo-Euclidean space, and the tensor calculus is then generalized to include a statement of the basic ideas of the general theory of relativity. (W.D.M.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Electromagnetic

Refer also to abstract 24216.

25219 (DESY–67/6) PHOTOPRODUCTION OF STRANGE PARTICLES AT ENERGIES UP TO 5.8 GeV. Erbe, R.; Reimann, G.; Schuettler, E.; (and others) (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar. 1967. 19p. Dep. mn.

Photoproduction of strange particles was studied in a hydrogen bubble chamber exposed to a bremsstrahlung beam with a maximum photon energy of 5.8 GeV. There were 1,200,000 pictures evaluated resulting in a total of 709 events with visible strange particle decays. The interactions $\gamma + p \rightarrow \gamma + K^+$, $\gamma + p \rightarrow \Sigma^0 + K^+$, $\gamma + p \rightarrow \Sigma^+ + K^0$, $\gamma + p \rightarrow \Lambda + K^+ + \pi^0$ (π^0 ...), $\gamma + p \rightarrow \Lambda + K^0 + \pi^+$, $\gamma + p \rightarrow \Sigma^+ + K^+ + \pi^-$, $\gamma + p \rightarrow \Sigma^- + K^+ + \pi^+$, $\gamma + p \rightarrow \Lambda + K^+ + \pi^+ + \pi^-$ are considered. (J.F.P.)

25220 BRANCHING RATIOS FOR THE DECAY OF VECTOR MESONS INTO LEPTON PAIRS. Hertzbach, S. S. (Johns Hopkins Univ., Baltimore); Kraemer, R. W.; Madansky, L.; Zdanis, R. A.; Strand, R. Phys. Rev., 155: 1461-7(Mar. 25, 1967).

The decays into lepton pairs of vector mesons (ρ, ϕ, ω) produced by a beam of 3-BeV/c π^- mesons incident on a liquid-H_2 target at the Brookhaven AGS were studied. The experiment utilized scintillation counters and spark chambers as well as a lead-scintillator "shower chember" constructed for the identification of electrons and rejection of background. A Monte Carlo technique was used to predict the background and determine the number of real events. For the muon-pair mode, the results are upper limits, with the branching ratio $(\rho \rightarrow \mu\bar{\mu})/(\rho \rightarrow \text{all modes})$ $< 14 \times 10^{-4}$ being the best limit determined. For the electron-pair decays $(\rho \rightarrow e\bar{e})/(\rho \rightarrow \text{all modes}) = (0.65^{+\frac{1}{0.5}}) \times 10^{-4}$ and $(\omega \rightarrow e\bar{e}/\omega \rightarrow \text{all modes}) = (1.0^{+\frac{1}{0.8}}) \times 10^{-4}$ for an assumed ϕ-ω mixing angle of 38°. Because of insufficient knowledge of the production process, a tentative result is quoted for the ϕ meson $\sigma_\phi \times (\phi \rightarrow e\bar{e})/(\phi \rightarrow \text{all modes}) = 0.31^{+\frac{3}{0.1}}$ μb. The results are compared with other experiments. (auth)

25221 PHOTOPRODUCTION OF ω^0 MESONS. Contract AT(30-1)-2752. Phys. Rev., 155: 1468-76(Mar. 25, 1967). (HUX-2752-16).

Data and methods of analysis are presented on the details of the reaction $\gamma + p \rightarrow p + \omega^0$ in a 12-in. hydrogen bubble chamber exposed to a bremsstrahlung photon beam of 6-BeV maximum energy at the Cambridge Electron Accelerator. The ω^0-production differential cross sections and decay angular distributions, at various photon-energy intervals, are compared with the predictions of the one-pion-exchange (OPE) model and the strong-absorption model (SAM). The experimental data seem to be in better agreement with the SAM predictions. However, much more data will be required for determining the exact role of the OPE mechanism in the photoproduction of ω^0 mesons. (auth)

25222 ANALYSIS OF γ-p REACTIONS IN A HYDROGEN BUBBLE CHAMBER TO 6.0 GeV: CROSS SECTIONS AND LABORATORY DISTRIBUTIONS. Contract AT(30-1)-2098. Phys. Rev., 155: 1477-88(Mar. 25, 1967). (MIT-2098-283).

An account is given of the experimental arrangement, the beam properties, and the methods of data analysis for a study of photon reactions in hydrogen at energies up to 6 BeV. The values of cross sections as a function of photon energy are presented for $\gamma + p \rightarrow p + \pi^0$, $\gamma + p \rightarrow n + \pi^+$, $\gamma + p \rightarrow p + \pi^+ + \pi^-$, $\gamma + p \rightarrow n + \pi^+ + \pi^+ + \pi^-$, $\gamma + p \rightarrow p + \pi^+ + \pi^- + \pi^0$, $\gamma + p \rightarrow p + \pi^+ + \pi^+ + \pi^- + \pi^-$, and $\gamma + p \rightarrow$ (strange particles), as well as a lower limit for the $\gamma + p$ total cross section. In addition, momentum and angular distributions in the laboratory system are given for protons and charged pions from the non-strange-particle reactions. (auth)

25223 π^+ PHOTOPRODUCTION FROM HYDROGEN AT LAB ANGLES FROM 34° TO 155° AND LAB PHOTON ENERGIES FROM 500 TO 1350 MeV. Thiessen, Henry A. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Phys. Rev., 155: 1488-96(Mar. 25, 1967). (CALT-68-95).

The differential cross section for the reaction $\gamma + p \rightarrow \pi^+ + n$ was measured using the Caltech 1.5-GeV electron synchrotron. The positive pions were detected and momentum analyzed in a multichannel magnetic spectrometer and the data were recorded in the memory of a pulse-height analyzer. The energy resolution was improved over previous experiments and an attempt was made to minimize systematic errors. The data are presented in the form of energy distributions at 12 lab angles from 34 to 155°, and the range of lab proton energies extended from 500 to 1350 MeV. Data were not taken at all energies for each angle, since the maximum useful momentum of the spectrometer, 600 MeV/c, restricted the maximum energy for lab angles less than or equal to 74°. (auth)

25224 PHOTOPRODUCTION OF CHARGED PION PAIRS FROM HYDROGEN WITH GAMMA ENERGIES UP TO 1500 MeV. Fretwell, Lyman J. Jr.; Mullins, Joe H. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Phys. Rev., 155: 1497-1504(Mar. 25, 1967).

Charged-pion-pair photoproduction was investigated up to a γ energy of 1500 MeV, using the Caltech 12-in. heavy-liquid bubble chamber with a small-diameter, high-intensity photon beam passing through a central beam-tube gaseous hydrogen target surrounded by the sensitive Freon. Scanning, analysis, and data-reduction techniques have been developed to deal with the problems of two-view stereo, hidden-event origins, absence of magnetic field, and the range-energy and multiple-scattering relationships that occur in the heavy materials. Roughly 5700 pictures were scanned and analyzed, yielding 754 acceptable events. Cross-section and parameter distributions are generally consistent with the results of previous experiments. The total cross section rises sharply from near zero at 500 MeV to order 80 μb at 650 MeV, then falls slowly to 40 μb at 1500 MeV. The presence of the ρ^0 is clearly seen in the pion pair production at higher energies. (auth)

25225 STUDY OF THE DECAY MODE $\eta \rightarrow \pi^+\pi^-\gamma$. Litchfield, P. J. (Rutherford High Energy Lab., Chilton, Eng.); Rangan, L. K.; Segar, A. M.; Smith, J. R.; Larribe, A.; Leveque, A.; Mueller, A.; Pauli, E.; Revel, D.; Tallini, B. Phys. Lett., 24B: 486-8(May 1, 1967).

One-hundred and sixty $\eta \rightarrow \pi^+\pi^-\gamma$ decays were extracted from the same η sample in which $\eta \rightarrow \pi^+\pi^-\pi^0$ decays were studied previously. The branching ratio $R(\eta \rightarrow \pi^+\pi^-\gamma)/(\eta \rightarrow \pi^+\pi^-\pi^0)$ is 0.25 ± 0.035. The data are also consistent with C invariance, the charge asymmetry being $A = -0.04 \pm 0.08$. (auth)

Weak

25226 DECAY CURVE OF THE POSITIVE PION IN THE REGION OF LARGE LIFE TIMES. Dunaitsev, A. F.; Kut'in, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Simonov, Yu. N. Yadern. Fiz., 5: 826-9(Apr. 1967). (In Russian).

The $\pi^+ \rightarrow \mu^+ + \nu$ decay curve was measured by means of a system of scintillation counters and a high-speed multi-ray oscilloscope. Owing to the use of a "trap" for positrons the background due to the $\mu^+ \rightarrow e^+$ decay was decreased up to the level lower than $3(10^{-6})$. The decay curve is traced up to 16 τ (where τ is the mean life time of the π^+-meson). No deviation from the exponential law is observed. (auth)

25227 TIME DEPENDENCE OF K^0_{e3} DECAYS. Feldman, L.; Frankel, S.; Highland, V. L.; Sloan, T.; Van Dyck, O. B.; Wales, W. D.; Winston, R.; Wolfe, D. M. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 155: 1611-17(Mar. 25, 1967).

An experiment was performed at the Brookhaven Cosmotron to detect the β decay of the products of the reaction $\pi^- + p \rightarrow \Lambda + K^0$. Spark-chamber photographs of 116 $K^0 \rightarrow \pi^+ + e^+ + \nu$ events were obtained, and the proper decay time of each K^0 was determined. The time distribution should be of the form $|1 + x|^2 e^{-\lambda_1 t} + |1 - x|^2 e^{-\lambda_2 t} - 4\mathrm{Im}(x) \sin\delta t\, e^{-(\lambda_1+\lambda_2)t/2}$, where λ_1 and λ_2 are the K_S and K_L decay rates, $\delta = m(K_L) - m(K_S)$, and x is the complex ratio of the $\Delta S = -\Delta Q$ amplitude to the $\Delta S = +\Delta Q$ amplitude. It was found that $\mathrm{Re}(x) = 0.17^{+\frac{3}{0.5}}$, $\mathrm{Im}(x) = 0.0 \pm 0.25$, a result inconsistent with a "maximal" violation of CP invariance. (auth)

25228 MEASUREMENT OF THE BRANCHING RATIOS OF $K^+_{\mu 2}$, $K^+_{\pi 2}$, $K^+_{\pi 3}$, AND $K^+_{\mu 3}$. Auerbach, L. B. (Univ. of Pennsylvania, Philadelphia); Dobbs, J. MacG.; Mann, A. K.; McFarlane, W. K.; White, D. H.; Cester, R.; Eschstruth, P. T.; O'Neill, G. K.; Yount, D. Phys. Rev., 155: 1505-15(Mar. 25, 1967).

In an experiment performed at the Princeton–Pennsylvania Accelerator with scintillation counters and spark chambers, the branching ratios were determined for the K^+ decay modes, $K^+_{\mu 2}$, $K^+_{\pi 2}$, $K^+_{\mu 3}$, and $K^+_{e 3}$. For each event, the momentum and range of the charged secondary and the time interval between the arrival of the K^+ and its decay were measured. The momentum was measured in thin-foil spark chambers placed in a magnetic field. The range was then measured in a thick-plate spark chamber

in which all charged products from K^+ decay were stopped. K^+ decays in flight were eliminated through use of the timing information. The solid angle and detection efficiency of the apparatus were constant over the momentum interval 130 to 260 MeV/c. Based on approximately 23,000 measured events, the values for the branching ratios are (63.34 ± 0.44)% for $K^+_{\mu 2}$, (20.59 ± 0.40)% for $K^+_{\pi 2}$, (4.97 ± 0.16)% for K^+_{e3}, and (3.82 ± 0.29)% for $K^+_{\mu 3}$. These values were determined by using for the τ and τ' branching ratios (5.58 ± 0.08)% and (1.70 ± 0.055)%, respectively. A table of weighted averages of all K^+ branching-ratio measurements is included. (auth)

Strong (Baryon-Induced)

25229 (CEA-R-3193) MESURE DES COEFFICIENTS DE CORRELATION DE SPINS A_{xx} ET A_{yy} DANS LA DIFFUSION p-p DE 11 A 26 MeV. (Spin Correlation Parameters A_{xx} and A_{yy} Measurements in p-p Scattering From 11 to 26 MeV). Catillon, Philippe; Chapellier, Maurice; Garreta, Denis (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1967. 75p. (In French). Dep.

The A_{xx} and A_{yy} spin correlation coefficients of the proton-proton scattering were measured at the laboratory energies of 11.40, 19.15, 23.45, and 26.50 MeV for the center of mass scattering angle 90°. These measurements were made by scattering a polarized proton beam on a polarized proton target. (auth)

25230 (DESY-67/4) THE REACTION $pp \rightarrow pn\pi^+$ AT 10 GeV/c AND THE OPE MODEL. Dehne, H. C.; Diaz, J.; Stroemer, K.; Schmitt, A.; Swanson, W. P.; Borecka, I.; Knies, G.; Wolf, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Feb. 1967. 15p. Dep. mn.

The reaction $p + p \rightarrow p + n + \pi^+$ and the process $p + p \rightarrow N^{*++}_{(1236)} n$ were measured at 10 GeV/c. The OPEM is compared with the isobar production and agreement with the data is better than a factor of two. (auth)

25231 PLANNING OF np-SCATTERING EXPERIMENTS ABOVE THE MESON PRODUCTION THRESHOLD. Legar, F.; Fedorov, V. V.; Yanout, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 5: 887-90(Apr. 1967). (In Russian).

The optimal experiment, necessary to determine the most probable of two phase shift sets at 400 and 630 MeV, is designed. Experiments determining the quantities D, R, A, C_{nn} and A_{ss} in pn-scattering are considered. It is shown that the most effective experiment is the measurement of the parameter D_{pn}. The measurements must be performed at 60 and 115° (c.m.s.) for 400 and 630 MeV, respectively. (auth)

25232 SPIN CORRELATION IN PROTON–PROTON SCATTERING AT 27 MeV. Jarmie, Nelson (Los Alamos Scientific Lab., N. Mex.); Brolley, J. E.; Kruse, Herald; Bryant, Howard C.; Smythe, R. Contract W-7405-eng-36. Phys. Rev., 155: 1438-43(Mar. 25, 1967). (LA-DC-7494).

The spin-correlation parameter C_{nn} for proton–proton scattering was measured at 90.00 ± 0.25° c.m. angle and 27.05 ± 0.10 MeV. The value obtained is $C_{nn} = -0.689 \pm 0.070$. The construction and operation of the apparatus is described, detailing the cryogenic targets and fast electronic logic. The analysis of the data is explained. Related experiments and the significance of this measurement in the investigation of nucleon–nucleon scattering are briefly discussed. (auth)

25233 STUDY OF HYPERFRAGMENTS. PART III. MULTI-NUCLEON INTERACTIONS OF Λ^0 IN HYPERFRAGMENTS. Burte, D. P.; Chaudhari, K. N.; Ganguli, S. N.; Rao, N. K.; Swami, M. S. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, 64: 203-12(Oct. 1966).

Examples of non-mesic decay of hyperfragments, produced by high-energy particles in nuclear emulsion stacks, were used to obtain information on multinucleon interaction of the hyperon (Λ^0) in the decay of hyperfragments. From a study of events with two fast charged particles in decays of hyperfragments, the following two conclusions are drawn: multinucleon interactions of Λ^0 in decay of hyperfragments is not significant, occurring at the most in a few percent of the cases; and there is strong evidence for the existence of final-state interactions in decay of hyperfragments. (auth)

Strong (Meson-Induced)

25234 (BNL-11175) FORWARD SCATTERING AMPLITUDES AT HIGH ENERGIES, DISPERSION RELATIONS, AND ASYMPTOTIC PREDICTIONS. Lindenbaum, S. J. (Brookhaven National Lab., Upton, N. Y.). Feb. 24, 1967. Contract AT(30-2)-Gen-16. 49p. (CONF-670108-2). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 4th Conference on Symmetry, Coral Gables, Fla.

A series of high accuracy determinations of the entire $\pi^{\pm}$-p forward scattering amplitudes were made, and a preliminary report of the results is presented. The proton–proton forward scattering was also measured in the 8 to 26 GeV/c range. Good agreement with theory is obtained. (J.F.P.)

25235 (BNL-11359) MEASUREMENT OF $\pi^{\pm}$p BACKWARD SCATTERING BETWEEN 1.54 AND 2.04 GeV/c. Carroll, A. S.; Fischer, J.; Lundby, A.; McDaniel, B. D.; Phillips, R. H.; Wang, C. L. (Brookhaven National Lab., Upton, N. Y.); Lobkowicz, F.; Melissinos, A. C.; Tewksbury, S. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). May 1, 1967. 21p. Dep. CFSTI.

Measurements were made at 1.54 and 1.95 GeV/c for $\pi^+ + p$ scattering and at 1.68 and 2.04 GeV/c for $\pi^- + p$ scattering. Differential cross sections are given. Over most of the angular range ($-0.7 < \cos\theta_{cm}$) the $\pi^{\pm} + p$ the differential cross sections show very little evidence for the resonance found in previous total cross section measurements. But the results agree with other results in the same momentum interval. (J.F.P.)

25236 (MIT-2098-301) MEASUREMENT OF THE PROCESS $K^- + P \rightarrow \bar{K}^0 + N$ AT 8 GeV/c. Technical Report No. 83. Buffington, Andrew (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Dec. 1966. Contract AT(30-1)-2098. 132p. Dep. CFSTI.

Thesis.

The MASCOT system was used to measure kaon elastic charge-exchange scattering at an incident momentum of 8 GeV/c with a liquid hydrogen target. The measured total cross section is 71 ± 21 microbarns, based on analysis of a fifth of the data. An angular distribution of the process was also measured. The details of design and construction of the MASCOT system as well as its calibration and application to this particular reaction are presented. (auth)

25237 (NYO-2171-218) $\pi^-p \rightarrow \pi^-\pi^+n$ AT 8 GeV/c. Yuta, H.; Baker, A.; Ehrlich, R.; Selove, W. (Pennsylvania Univ., Philadelphia). July 23, 1966. Contract AT(30-1)-2171. 20p. (CONF-660808-24). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 13th International Conference on High Energy Physics, Berkeley, Calif.

The results of interactions of the type $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ are given. These results were obtained from 100,000 pictures taken in the bubble chamber. Decay angular distributions for the ρ^0 and the f^0 bands and production distributions in momentum transfer are shown. The data are consistent with the existence of the g(1765). (J.F.P.)

25238 (RHEL/R-104) KINEMATICAL ANALYSIS OF TWO NEUTRAL PI-MESON FINAL STATES. Carroll, A. S.; Middlemas, N.; Williams, W. S. C. (Rutherford High Energy Lab., Chilton (England)). July 1965. 14p. Dep. HMSO 2s. 6d.

A method for event analysis, which permits accurate kinematic reconstruction although the only information available is the direction of four gamma rays and event samples are heavily contaminated with events in which more than two mesons (π^0) are produced but only four gamma rays materialize, is given. The analysis makes use of the fact that the distribution of opening angles between the two gamma rays in meson (π^0) decay is strongly peaked near the minimum allowed. Thus the observed opening angle, once identified, is a good measure of the total energy of the meson (π^0) and the bisector a good measure of the meson (π^0) direction of motion. The reaction considered is $\pi^- + p \rightarrow \pi^0 + n$ at 2.00 GeV/c. (J.F.P.)

25239 ABSORPTION OF π^+-MESONS WITH ENERGY 70 MeV BY NUCLEI OF PHOTOEMULSION. Kirillov-Ugryumov, V. G.; Sergeev, F. M.; Fesenko, A. I. Yadern, Fiz., 5: 851-4(Apr. 1967). (In Russian).

The absorption of π^+ mesons with energy 70 ± 8 MeV by complex nuclei is investigated by means of the photoemulsion method. For two-prong events the yields of fast nucleons and deuterons are found to be (89.1 ± 7.0)% and $(10.9^{+7.3}_{-4.0})$% respectively. The measured momentum angular distributions are discussed on the basis of the idea that the π^+ meson is captured by a pair of nucleons in a low-energy state. (auth)

25240 INELASTIC π^-p-INTERACTIONS AT 7.5 GeV. FOUR-PRONG EVENTS WITH PROTONS. Belyakov, V. A.; Kladnitskava, E. N.; Kuznetsova, E. S.; Balya, O.; Mikhul, A.; Sabeu, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 5: 834-47(Apr. 1967). (In Russian).

729 events of the reaction $\pi^-p \rightarrow \pi^-\pi^+\pi^-p + m\pi^0$ ($m \geq 0$) at 7.5 GeV are analyzed on photographs obtained in the 24-liter propane bubble chamber. The cross section of the reactions is found to be $\sigma = 5.1 \pm 0.3$ mb. The total cross section of the four-prong interactions with no strange particle creation amounts to 8.8 ± 0.4 mb. The momenta and angular distributions of protons, π^+- and π^--

mesons are investigated. The proton angular distribution in the c.m. system is highly asymmetrical with the protons emitted mainly in the backward direction. π-mesons are emitted mainly in the forward direction, while the π^--distribution is more asymmetrical. There is a correlation between transverse and longitudinal particle momenta in the c.m. system that can not be explained in the framework of the statistical model. Production of meson and baryon resonance states is studied. Creations of the $N^+_{3,3}$* and $N^0_{3,3}$ are distinctly observed in reactions with no π^0-meson and in reactions involving π^0-mesons. Production of the ρ^0-meson is observed mainly in the events with no π^0-meson. Effective mass distributions for the $(\pi^+\pi^-\pi^-)$-, $(p\pi^+\pi^-)$- and $(p\pi^-\pi^-)$- systems are not in accordance with the phase-space curves. (auth)

25241 INVESTIGATION OF THE π^- EXCHANGE SCATTERING BY LIGHT NUCLEI AT 2.8 GeV/c. Veselovskii, G. S.; Davidenko, G. V.; Kuznetsov, E. V.; Lomanov, M. F. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 5: 848-50(Apr. 1967). (In Russian).

The exchange scattering of mesons (π^-) with momentum of 2.8 GeV/c by light nuclei is investigated by means of the 200-liter bubble chamber filled with a freon mixture. The angular distribution of the mesons (π^0) and the exchange scattering cross section are obtained. (J.F.P.)

25242 REACTION $K^-p \to \Lambda\omega$ FROM 1.2 TO 2.7 GeV/c: THE ABSORPTION MODEL WITH STRANGE-MESON EXCHANGE. Flatte, Stanley M. (Univ. of California, Berkeley). Phys. Rev., 155: 1517-38(Mar. 25, 1967). (UCRL-16648(Rev.)).

An analysis was made of over 9000 $K^-p \to \Lambda\omega \to (p\pi^-)(\pi^+\pi^-\pi^0)$ events in four momentum regions between 1.2 and 2.7 GeV/c. The differential cross section and the 11 independent decay-correlation parameters were systematically determined as a function of production angle for each of the four momentum regions. A striking forward peak in the differential cross section at our highest momentum, 2.6 BeV/c, suggests the appearance of strange-meson exchange. Using a new formalism for the absorption model, it is shown that the behavior of the differential cross section and the decay-correlation parameters at 2.6 BeV/c as a function of production angle is qualitatively explained by the absorption model with K and K* exchange. Using available data on $K^-p \to \Lambda\phi$ at 2.6 BeV/c, it is shown that the absorption model also explains the behavior of $K^-p \to \Lambda\phi$, and that the comparison between the couplings of $K^-p \to \Lambda\omega$ and $K^-p \to \Lambda\phi$ is in reasonable agreement with SU(3) predictions. (auth)

25243 POLARIZATION AND ANGULAR DISTRIBUTIONS OF Σ^0 FROM $\pi^-p \to K^0\Sigma^0$ NEAR 1.3 GeV/c. Crolius, R. L.; Cook, V.; Cork, Bruce; Keefe, D.; Kerth, L. T.; Layson, W. M.; Wenzel, W. A. (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev., 155: 1455-60(Mar. 25, 1967). (UCRL-16089(Rev. 2)).

Production of $\Sigma^0 + K^0$ by π^-'s incident on liquid hydrogen was studied in the π^- momentum region from 1200 to 1400 MeV/c. By means of spark chambers, the Σ^0 production angular distribution and polarization were measured at four incident π^- momenta. Significant polarization, $\alpha_\Delta P_\Sigma = -0.71^{+.33}_{-.29}$, exists in the backward hemisphere of Σ^0 production in the π^- momentum region from 1300 to 1350 MeV/c. (auth)

25244 INTERACTIONS OF 1.5 GeV/c K^- MESONS WITH EMULSION NUCLEI. GENERAL CHARACTERISTICS, PRODUCTION, AND DECAY OF HYPERFRAGMENTS. Cuevas, J.; Diaz, J.; Harmsen, D. M.; Just, W.; Lohrmann, E.; Schink, L.; Spitzer, H.; Teucher, M. W. (Univ., Hamburg. Deutsches Elektronen-Synchrotron, Hamburg). Nucl. Phys., B1: 411-33(1967).

Data are given on 141 stars found by a scan along the track of 1.5 GeV/c K^- mesons in nuclear emulsion. The mean free path is 47 ± 4 cm. In an area scan, 1270 hyperfragments were observed, corresponding to a directly observed production rate of (3.1 ± 0.1)%. The corrected production rate is 7.6%. The production rate in light (CNO) nuclei is (1-2)%, and in heavy (Br,Ag) nuclei it is 9%. Details on 88 mesic hyperfragments are given, of which 43 could be uniquely identified. Three heavy mesic hyperfragments give for the binding energy $B_\Lambda < 27$ MeV. One π^+ decay of a Li hyperfragment was observed. The nonmesic decay of heavy (spallation-) hyperfragments proceeds mostly by neutron stimulation. The stimulation ratio is $\gamma = P_n/(P_n + P_p) \approx 0.9$. Production of fission hyperfragments was studied using two independent criteria for fission events. Our best estimate is 2–4% for the fraction of fission hyperfragments among all observed Br or Ag hyperfragments. (auth)

25245 A $\rho^-\pi^-$ ENHANCEMENT AT 1.32 GeV OBSERVED IN 5 GeV/c π^-d INTERACTIONS. Vanderhagen, R. (Ecole Polytechnique, Paris); Huc, J.; Fleury, P.; (and others). Phys. Lett., 24B: 493-6(May 1, 1967).

In the reaction $\pi^-d \to pp\pi^-\pi^-\pi^0$ at 5.04 GeV/c, a $\rho^-\pi^-$ enhancement at 1.32 GeV is observed. Its statistical significance is about 4 standard deviations. The production cross section (15 μb) excludes its identification with the $(\rho^0\pi^-)$ A_2 resonance. (auth)

25246 PRODUCTION OF A $Y^*_1(1700)$ IN K^-p COLLISIONS AT 6 GeV/c. Colley, D. C. (Univ. of Birmingham, Eng.); MacDonald, F.; Musgrave, B.; (and others). Phys. Lett., 24B: 489-91(May 1, 1967).

An enhancement is observed in $\Lambda^0\pi^+$ effective mass in the reaction $K^- + p \to \Lambda^0 + \pi^+ + \pi^-$ at 6 GeV/c. The lack of any large enhancements in other final states, as well as the shape and position of the peak, suggest that it is due to the new hyperon resonance, the Y^*_1 (1700), since it cannot be explained in terms of the known Y^*_1 (1660) and Y^*_1 (1765). (auth)

25247 SPIN AND PARITY OF THE K*(1420) MESON. Goldberg, Marvin (Syracuse Univ., N. Y.); Goz, Barton; Leitner, Jack; Barnes, Virgil E.; Dornan, Peter J.; Kalbfleisch, George R.; Skillicorn, Ian O. Phys. Rev. Lett., 18: 680-4 (Apr. 17, 1967).

An analysis of a relatively clean K* (1420) sample, in which use is made of the production dynamics to ascertain the resonance alignment, is reported. Although model-dependent assumptions are used, the inherent discrimination among spin–parity is so marked that the analysis is sufficient to rule out 1^- conclusively, and to make 3^- unlikly. The data come from 4.6- and 5-GeV/c K^--p interactions. There were 1180 and 1500 events respectively of the type $K^- + p \to K^0 + \pi^- + p$ and $K^- + p \to K^0 + \pi^+ + \pi^- + n$. (J.F.P.)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 25422.

General

25248 (JINR–P2-3244) ALGEBRA PLOTNOSTEI I FORM-FAKTORY. (Algebra of Current Densities and Form Factors). Efremov, A. V.; Stepanov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 6p. (In Russian). Dep.

It is shown that the covariant formulation of the current density algebra, in the case when it is limited in the intermediate state by the same multiplet as the initial and final one, leads to the system of equations for form factors. This system has only a trivial solution, i.e., normal form factors are equal identically to 1, while anomalous ones are equal to 0. (auth)

25249 (NP–16680) RECURRENT RELATIONS FOR THE MULTIPLICITIES OF WEIGHTS AND FOR THE MULTIPLICITIES OF REPRESENTATIONS OF A COMPLEX SEMISIMPLE LIE ALGEBRA. Klimyk, A. U. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1966. 24p. Dep.

A recurrent relation for the multiplicities of the weights of finite-dimensional irreducible representations of a complex semisimple Lie algebra which allows one to compute these multiplicities comparatively easily is derived. (J.F.P.)

25250 INVESTIGATION OF DIRAC'S EQUATION IN RIEMANNIAN SPACE. Stanyukovich, K. P. Dokl. Akad. Nauk SSSR, 170: 1285-7(Oct. 21, 1966). (In Russian).

Starting with the Riemann spinor space, the covariant derivative is determined, using the infinitesimal operator which controls the algebra of the group; from that, the impulse operator is obtained, applying it to the spinor function. The covariant Dirac equation is then determined, making use of the spin of the particle; then further derivatives, involving Lorentz groups, the Ricci radius of curvature and the cross sections for gravitational and strong interactions are introduced. An expression is finally obtained, characterizing the relative energies of the nucleon and the graviton. It is shown that for distances of the order of $r_g \cdot 10^{-20} = 10^{-33}$ cm whereby r_g is about 10^{-13} cm, the characteristic radius of elementary particles, Dirac's equation may be applicable in a gravitational field. (TTT)

25251 CHARGE SUPERSELECTION RULE. Aharonov, Yakir; Susskind, Leonard (Yeshiva Univ., New York). Phys. Rev., 155: 1428-31(Mar. 25, 1967).

Questions concerning superselection rules are considered. Two experiments are discussed. In the first, coherent superpositions of different angular-momentum states are constructed. In the second, coherent superpositions of states with different charge are constructed in complete analogy with the angular-momentum case. It is suggested that, contrary to a widespread belief, interference may be possible between states with different charges. (auth)

25252 NON-DYNAMICAL INTEGRAL METHOD FOR PARITY DETERMINATION. Kozlowski, M.; Werle, J. (Inst. for Nuclear Research, Warsaw). Nucl. Phys., B1: 362-8 (1967).

A nondynamical integral method for determining the parity of unstable particles is proposed. In the case of fermions it consists in measuring the up-down asymmetry of the angular distribution in parity violating decays of the type $S \rightarrow \frac{1}{2} + 0$. A similar method can be used in the case of parity conserving three-particle decays of the type $S \rightarrow \frac{1}{2} + 0 + 0$ provided that the corresponding asymmetry is measured in the distribution of the normal to the decay plane. The procedure based on the transversity representation is fully relativistic. (auth)

Electromagnetic

Refer also to abstracts 24944 and 25322.

25253 (JINR-P2-3227) OB OPREDELENII ELEKTROMAGNITNYKH FORM-FAKTOROV CHASTITSY SO SPINOM 1. (On the Determination of Electromagnetic Form Factors of the Spin 1 Particle). Doan Nhuong (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 16p. (In Russian). Dep.

The electromagnetic vertex of the spin-1 particle is defined by four form factors: G_1, G_2, G_3, G_4 (the T-invariance is assumed to be violated). An experiment is suggested for determination of these form factors in different physical regions of the momentum transfer. (auth)

25254 (SLAC-Trans-63) PROPERTIES OF ANNIHILATION CROSS-SECTIONS OF A POLARIZED ELECTRON-POSITRON PAIR. Baier, V. N.; Khoze, V. A. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated for Stanford Linear Accelerator Center, Calif., from Preprint 82. 9p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A study is made of some properties of the annihilation cross-section of a polarized electron-positron pair. The general aspect of the complete annihilation cross-section of an arbitrarily polarized electron-positron pair in an ultrarelativistic limit is found. An investigation is made of the creation processes of pseudoscalar mesons and linearly polarized photons in the annihilation of a transversly polarized pair. Exact cross-sections are derived for the processes $e^+ + e^- \rightarrow \mu^+ + \mu^- + \gamma$ and $e^+ + e^- \rightarrow s^+ + s^- + \gamma$ in the initial transversely-polarized pair. (auth)

25255 ON THE POSSIBILITY OF OBSERVING T-ODD SPIN CORRELATIONS IN THE COMPTON EFFECT ON PROTONS. Dolgov, A. D.; Marinov, M. S.; Ponomarev, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 5: 870-3(Apr. 1967). (In Russian).

The left-right asymmetry in the angular distribution in the elastic photon scattering by a polarized proton target due to the electromagnetic complexity of the amplitude is shown to be no less than the asymmetry due to a T-violating interaction provided the latter be not anomalous strong. (auth)

25256 ON π^0-MESONS PRODUCTION IN THE REACTION $e^- + e^+ \rightarrow \mu^- + \mu^+ + \pi^0$. Arutyunyan, V. M.; Shakhnazaryan, Yu. G. Yadern. Fiz., 5: 874-6(Apr. 1967). (In Russian).

The theoretical analysis of the reaction $e^- + e^+ \rightarrow \mu^- + \mu^+ + \pi^0$ is given taking into account the intermediate resonance states. (auth)

25257 MEASUREMENT OF G_{En} FROM ELASTIC e-d SCATTERING: RELATIVISTIC CORRECTIONS AND MODEL DEPENDENCE. Casper, B. M.; Gross, Franz (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 155: 1607-10(Mar. 25, 1967).

Relativistic corrections to elastic e-d scattering are evaluated and shown to be large enough to account for the discrepancy between e-d scattering and thermal-neutron measurements of the slope of G_{En}. (auth)

25258 PAIR PRODUCTION IN PHOTON–PHOTON COLLISIONS. Gould, Robert J.; Schreder, Gerard P. (Univ. of California, San Diego, La Jolla). Phys. Rev., 155: 1404-7(Mar. 25, 1967).

General formulas for the absorption probability from the process $\gamma + \gamma' \rightarrow e^+ + e^-$ are given for high-energy photons traversing isotropic photon gases having various spectra. Asymptotic formulas are derived and general results are given in graphical form for photon spectra having blackbody and power-law form. The results will be applied to calculate the absorption probability for high-energy photons traversing cosmic distances. (auth)

25259 PHENOMENOLOGICAL ANALYSIS OF THE PHOTOPRODUCTION OF NEUTRAL VECTOR MESONS AND STRANGE PARTICLES. Harari, Haim (Stanford Univ., Calif.). Contract AT(04-3)-515. Phys. Rev., 155: 1565-78(Mar. 25, 1967). (SLAC-PUB-239).

Branching ratios for photoproduction of vector mesons and strange particles are discussed. The one-pion-exchange mechanism cannot explain the observed ratio between ρ and ω photoproduction cross sections. Various versions of pseudoelastic mechanisms are studied and it is shown that although they correctly predict the large $\rho:\omega$ production ratio, they cannot account for the extremely small preliminary cross section for φ production. It is shown that no combination of one-pion exchange and the diffraction mechanism with exact or broken SU(3) can explain the low φ production rate. The multiperipheral model may explain the low φ production, but predicts the wrong $\rho:\omega$ production ratio. Various possible sources of this discrepancy are studied and experimental tests are discussed which can distinguish between the different proposed theories. A large number of new predictions based on exact or broken SU(3) symmetry are derived and compared with experiment. (auth)

25260 n–p MASS DIFFERENCE IN AN SU_2 BOOTSTRAP MODEL. Goldberg, Hyman (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 155: 1727-9(Mar. 25, 1967).

The possibility that $M_n > M_p$ is demonstrated in an off-shell, SU_2-symmetric, reciprocal bootstrap model of the N and the $\Delta[N^*(1238)]$. Only the static electrical potential between charged pions and the proton is used as a driving term. However, the change in the Δ-exchange contribution to the strong forces (due to the electromagnetic mass shifts in the Δ isoquartet) may be more than enough to reverse the "intuitive" result, $M_p > M_n$. (auth)

25261 INTERPRETATION OF THE N* EFFECT IN DEUTERON COMPTON SCATTERING. Month, Melvin (Univ. of Illinois, Urbana). Phys. Rev., 155: 1689-93(Mar. 25, 1967).

Calculations of deuteron Compton scattering based on impulse methods demonstrate a peaking of the energy distributions due to the N* pole in the factored nucleon amplitude. It is suggested here that the factorization procedure is questionable when a pole exists in the factored amplitude, as is evidenced, for example, by the failure of the procedure near threshold where the nucleon pole term is of importance. This difficulty is obviated by correctly treating the N* as an intermediate state. It is shown that there exists a singularity which extends into the so-called anomalous region, very close to the physical scattering domain. This Landau singularity, manifested in a diagram having four propagators, has the effect of simulating a resonance-like behavior just above the N*-nucleon threshold. However, this "resonance" has the interesting properties that as the deuteron momentum transfer increases, its effective width enlarges, while the peak height substantially diminishes. Using the dominance of the above mentioned singularity as the basis for a computation, an expression for the deuteron Compton differential cross section was derived. To avoid ambiguities inherent in the spin case, scalar particles were used. A comparison with the limited experimental data available above the photopion threshold produced very encouraging results. However, to further clarify the manner in which the N* manifests itself, it is suggested that attempts be made to extend the experiments (1) to a photon lab momentum of at least 350 MeV/c (the expected peak value) and (2) to the center-of-mass forward hemisphere, where the cross sections are anticipated to be both appreciably increased and more sharply peaked in the vicinity of the "N*." (auth)

25262 NUCLEON FORM FACTOR. Huszar, Miklos (Central Research Inst. for Physics, Budapest). Magyar Fiz. Foly., 14: 545-53(1966). (In Hungarian).

The scattering of high-energy electrons by nucleons represents an efficient method for studying the structure of nucleons; therefore, the information that may be derived from scattering cross-section data was examined, using the proton–electron scattering as an example. A generalized form of the matrix element of the proton flux was derived, including two unknown functions in the expression. These "form factors" make it possible to express and to measure the cross section and to compare theoretical and experimental values. In nonrelativistic quantum mechanics, the form factor is represented by the Fourier transform of the space-charge distribution; similar results are obtained in the expression for the distribution of the magnetic momentum, characterized by the magnetic form factor. Form factors may be calculated from dispersion correlations, using certain simplifying assumptions. (TTT)

25263 IMPORTANCE OF MESIC ATOMS IN NUCLEAR PHYSICS AND ELEMENTARY-PARTICLE PHYSICS. Backenstoss, G. (CERN, Geneva). Z. Naturforsch., 21a: 1751-7 (1966). (In German).

From meson atomic spectra, meson masses can be accurately

obtained and the electromagnetic properties of muons (vacuum polarization) can be proved. Charge distributions and the nuclear moment of spherical and deformed nuclei were determined with the aid of muon atoms with accuracy. These determinations are difficult or impossible with other methods. Pion atoms yield direct data on the pion-nucleon interactions. (tr-auth).

25264 CURRENT ALGEBRA DESCRIPTION OF DOUBLE PION PHOTOPRODUCTION. Carruthers, P.; Huang, H. W. (Cornell Univ., Ithaca, N. Y.). Phys. Lett., 24B: 464-6(May 1, 1967).

The reaction $\gamma N \to 2\pi N$ is studied in the limit in which one pion is "soft." The matrix element is shown to be dominated by the equal time commutator term, $\langle N\pi|A_{\mu}|N\rangle$, thus providing a new way to measure the latter matrix element. The dominant contribution is shown to coincide with the interaction current terms in the static model description of Cutkosky and Zachariasen, and hence to agree with experiment near the $\Delta(1238) + \pi$ threshold. Similar considerations hold for radiative scattering, $\pi N \to \pi N\gamma$. (auth)

25265 ELECTROMAGNETIC CORRECTIONS TO THE WEAK $\Delta S = 0$ VECTOR COUPLING CONSTANT. Abers, Ernest S.; Norton, Richard E.; Dicus, Duane A. (Univ. of California, Los Angeles). Phys. Rev. Lett., 18: 676-80(Apr. 17, 1967).

The electromagnetic renormalization of the $\Delta S = 0$ weak vector coupling constant G_V coming from the corrections to the vector part of the weak Hamiltonian is a universal divergent constant, independent of the details of the strong interactions. (auth)

25266 ELECTROMAGNETIC FORM FACTORS IN THE BOOTSTRAP THEORY. Noga, M. (Comenius Univ., Bratislava). Nucl. Phys., B1: 301-8(1967).

It is shown that form factors calculated within the framework of the Dashen–Frautschi off-the-mass-shell bootstrap method have the same analytical properties as those prescribed by the S-matrix theory, i.e., only unitary cuts are present. The discontinuity calculated along these cuts satisfies the unitarity condition only when certain relations among various coupling constants are fulfilled. Using these relations, the ratios among the isovector magnetic moment of the nucleon, magnetic dipole of the $\Delta \to N + \gamma$ transition and isovector magnetic moment of the Δ-resonance are calculated. The results are the same as those following from on-the-mass-shell bootstrap method and from the Lie group methods of the strong-coupling model. (auth)

Weak

Refer also to abstract 25265.

25267 (JINR-P2-3197) ROZHDENIE π-MEZONOV V NEITRINNYKH EKSPERIMENTAKH I ALGEBRA TOKOV. (π-Meson Production in Neutrino Experiments and Current Algebra). Nguyen Thi Hong (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 7p. (In Russian). Dep.

The cross sections of slow π-meson production processes by the collisions of neutrino and antineutrino with nucleons are calculated on the basis of simultaneous commutation relations of vector and axial currents. (auth)

25268 BEHAVIOR OF NEUTRAL K-MESONS UNDER RELATIVISTIC WAVE EQUATION. Su, Der-ruenn (National Taiwan Univ., Taipei, Taiwan). Chin. J. Phys. (Taiwan), 4: 77-8(Oct. 1966).

The condition under the relativistic wave equation viz. the square root Klein-Gordon equation is used to test the behavior of neutral K-mesons. Because K_1^0 and K_2^0 do not satisfy the condition of the relativistic wave equation, it is concluded that $K_{1,2}^0$ mesons may not be elementary particles, although they satisfy the Klein-Gordon equation. (auth)

25269 CURRENT–CURRENT PICTURE, FACTORIZATION IN S-WAVE τ DECAY, AND NATURE OF THE $|\Delta T| = \frac{1}{2}$ RULE. Pati, J. C.; Oneda, S. (Univ. of Maryland, College Park). Phys. Rev., 155: 1618-20(Mar. 25, 1967).

It is pointed out that the matrix elements obtained by the factorization procedure from the starting current–current interaction does play a dominant role even for the symmetric part of $K \to 3\pi$ decay amplitudes. Therefore, the $K \to 3\pi$ rates will provide a possible criterion of the primary versus dynamical nature of the $|\Delta T| = \frac{1}{2}$ rule. (auth)

25270 STRUCTURE OF THE $K \to \pi$ VERTEX AND NONLEPTONIC K-MESON PROCESSES IN THE POLE MODEL. Oneda, S.; Pati, J. C. (Univ. of Maryland, College Park). Phys. Rev., 155: 1621-3(Mar. 25, 1967).

A plausible estimate of the strength of the K-π vertex is made, consistent with the rate of $K \to 3\pi$ decay as well as with independent estimates based on current algebra and partially conserved axial-vector current (PCAC), on the one hand, and a dynamical model of hyperon decays on the other. The implications of this value for the K-π vertex on related K-meson processes of current interest are discussed. The results are consistent with the octet transformation property of the strangeness-changing weak nonleptonic interaction. (auth)

25271 INNER BREMSSTRAHLUNG IN LOW-ENERGY ELECTRON–NEUTRINO (ANTINEUTRINO) SCATTERING. Ram, Michael (Johns Hopkins Univ., Baltimore). Phys. Rev., 155: 1539-53(Mar. 25, 1967).

The differential and total cross sections were calculated for electron-neutrino (antineutrino) scattering accompanied by hard-photon emission. A numerical analysis of these cross sections including the radiative corrections to order α, soft-photon emission, and neutrino (antineutrino) electromagnetic form-factor interference terms calculated by Lee and Sirlin was performed, and the results are given graphically. (auth)

25272 CURRENT ALGEBRA AND PION PRODUCTION IN HIGH-ENERGY NEUTRINO–NUCLEON COLLISIONS. Gupta, K. C. (Univ. of Delhi). Phys. Rev., 155: 1758-61(Mar. 25, 1967).

Using the [current, charge] equal-time commutation relations and the hypothesis of partially conserved axial-vector current, a number of sum rules between off-mass-shell matrix elements were obtained for the high-energy neutrino-nucleon "inelastic" processes. In addition, the SU(3) × SU(3) chiral algebra has enabled the pion-production matrix element to be expressed in terms of β-decay form factors in a most straightforward manner. The results obtained are in reasonable agreement with the experimental data available and the previous models. (auth)

25273 FADDEEV EQUATIONS FOR THE $K \to 3\pi$ AMPLITUDE. Barbour, I. M.; Schult, R. L. (Univ. of Illinois, Urbana). Phys. Rev., 155: 1712-24(Mar. 25, 1967).

Integral equations for the three-pion decay amplitude of the K meson are derived in the context of a potential-scattering model. Nonlocal S- and P-wave separable potentials are used. Some numerical solutions are presented for the S-wave case. The shapes of the decay spectra are found to be insensitive to the shape of the potential for the cases investigated. The connection with the integral equations of Khuri and Treiman is discussed. A zero-range approximation requires that $a_{\frac{1}{2}}^{\frac{1}{2}} > a_{\frac{3}{2}}^{\frac{1}{2}}$ in order to fit the experimental data. Some aspects of three-body states in the presence of a resonance are investigated. No observable effects of a triangle singularity are found for the cases considered. (auth)

25274 NEUTRAL K DECAYS INTO $\pi^0\gamma\gamma$. Selva, A. Della; De Rujula, A.; Mateev, M. (International Center for Theoretical Physics, Trieste, Italy). Phys. Lett., 24B: 468-70(May 1, 1967).

It is experimentally rather difficult to distinguish the CP-nonconserving reaction $K_2^0 \to \pi^0\pi^0$ from the CP-conserving $K_2^0 \to \pi^0\gamma\gamma$ decay. Hence a theoretical study of their relative probability is desirable. The branching ratio $\Gamma(K_2^0 \to \pi^0\gamma\gamma)/\Gamma(K_2^0 \to \pi^0\pi^0)$ is estimated in the soft pion limit using PCAC hypothesis, current algebra commutation relation and a theoretical calculation by Barger for the decay rate $K_1^0 \to \gamma\gamma$. (auth)

25275 INTERMEDIATE VECTOR BOSON CONTRIBUTION TO THE MUON'S ANOMALOUS MAGNETIC MOMENT. Burnett, T.; Levine, M. J. (Univ. of California, San Diego, La Jolla). Phys. Lett., 24B: 467-8(May 1, 1967).

The contribution of the intermediate vector boson in weak interactions to the muon magnetic moment is re-evaluated, using a set of computer programs to manipulate Dirac matrices. For zero W anomalous magnetic moment, K, the result agrees with that of Shaffer (Phys. Rev., 133: B 187 (1964)), who considered only K = 0. The dependence upon K agrees with that of Brodsky and Sullivan (SLAC-PUB-242). (L.B.S.)

25276 PION–ANTIPION LIFETIME COMPARISON. Ayres, D. S.; Caldwell, D. O.; Greenberg, A. J.; Kenney, R. W.; Kurz, R. J.; Stearns, B. F. (Univ. of California, Berkeley). Phys. Lett., 24B: 483-5(May 1, 1967). (UCRL-17417).

A measurement of the difference between π^+ and π^- lifetimes gave $(\tau_+/\tau_-) - 1 = 0.0056 \pm 0.0028$, while the absolute π^+ lifetime was found to be 26.6 ± 0.2 ns. (auth)

25277 SUM RULES FOR AXIAL-VECTOR COUPLING-CONSTANT RENORMALIZATION. Iwao, S. (Univ., Bern). Nucl. Phys., B1: 117-26(1967).

Exact sum rules of Adler–Weisberger type are derived for all the possible weak semileptonic decays of baryons by making use of the equal-time commutator of the strangeness-nonchanging and -changing axial-vector currents. The rules containing the axial-vector coupling-constant renormalizations (avccr's) $g_A(\Xi)$. $g_A(\Sigma)$ and $g_A(\Sigma\Lambda)$ can be treated as was discussed before. Those derived from $\Delta S \neq 0$ transition matrix elements contain

not only information on the sizes of avccr's but also on their signs. For this class of rules it is only suggested how to treat the continuum contribution. The effective renormalizations of the avccr's in the new rules are large for the $\Delta S = 0$ current while those for the $\Delta S = 1$ current are comparable in magnitude to that for the neutron beta decay, except in one case. (auth)

Strong (General)

Refer also to abstract 25352.

25278 CURRENT ALGEBRAS AND CONFIGURATION MIXING. Coester, F. (Argonne National Lab., Ill.). Phys. Rev., 155: 1647-8(Mar. 25, 1967).

Assigning mixed configurations to hadron states implies an auxiliary space of "one-particle states" that contains more states than does the space of observable particles and resonances. An approximate model Hamiltonian that has all these states as one-particle eigenstates implies a corresponding modification of the unitary representations of the Lorentz transformations. This in turn requires a modification of the weak-interaction current operators if their tensor transformation properties are to be maintained. The formal construction of such models is described and the relations between the exact and the approximate quantities are examined. (auth)

25279 SOME REMARKS CONCERNING SCATTERING IN A QUARK MODEL. Chiu, Y. T. (Univ. of Chicago). Phys. Rev., 155: 1579-82(Mar. 25, 1967).

A hierarchy of sum rules on scattering cross sections are derived under much less restriction than previously assumed. New sum rules and real parts are discussed. (auth)

25280 GENERATION OF RESONANCES VIA INELASTIC EFFECTS. Saperstein, Alvin M. (Wayne State Univ., Detroit). Phys. Rev., 155: 1730-5(Mar. 25, 1967).

The N/D single-channel equations using a pole-dominated force and a simple model for the variation of the ratio of the total to the elastic partial-wave cross section are studied. It is found that inelasticity can lower and sharpen existing resonances, produce new resonances, and raise the maximum energy at which resonances are possible. (auth)

25281 DOMINANCE OF U-CHANNEL EXCHANGE AMPLITUDES IN ELASTIC SCATTERING. Kottler, H.; Foldy, L. L. (Case Inst. of Tech., Cleveland). Phys. Rev., 155: 1736-43 (Mar. 25, 1967).

General elastic processes of the type $A + B \rightarrow A + B$ (s-channel) assumed invariant under some arbitrary internal symmetry group G, are considered and the amplitudes for these processes are expressed in terms of contributions from reduced amplitudes associated with irreducible representations of G for the corresponding u-channel processes $A + \bar{B} \rightarrow A + \bar{B}$. The essential problem is to determine which of these reduced amplitudes can dominate the u-channel contribution to the s-channel processes, in the sense of asking which can be the only single reduced amplitude that can contribute. Restricting G to compact, connected semisimple Lie groups and employing elastic unitarity, it is shown that the only reduced amplitude which can dominate the u channel is that associated with the maximum-weight representation of G in the u channel. In the process of proving this dominance theorem, some sign properties for the elements of the s- to u-channel crossing matrix are also proved. The possible relevance of these properties to bootstrapping is briefly discussed. (auth)

25282 SIMPLIFIED MODEL FOR A THREE-PARTICLE REGGE TRAJECTORY. Drummond, Ian T. (Cambridge Univ., Eng.). Phys. Rev., 155: 1749-57(Mar. 25, 1967).

Final-state-interaction theory is generalized to the case of a Reggeon (that is, a particle with mass-dependent spin) which decays into three particles, any two of which can undergo a resonant S-wave interaction. It is shown that the residue functions which describe the coupling of the Reggeon to the three-particle state can be used to calculate the corresponding contribution to the imaginary part of the trajectory function. This contribution is not guaranteed to be positive. The formula also predicts the correct unstable two-particle discontinuity associated with the particle-resonance configuration of the final state. (auth)

25283 UNIVERSALITY AND REGULARITIES OF THE DEVIATION OF STRONG INTERACTIONS OF HADRONS. Matumoto, Ken-iti (Kanazawa Univ., Japan). Progr. Theoret. Phys. (Kyoto), 37: 143-9(Jan. 1967).

The characteristics of the strong interactions of hadrons are investigated phenomenologically. It is shown that baryon-baryon-meson interactions have a certain kind of universality and regularity of the deviation if the interaction Hamiltonians are written down under an appropriate principle (namely, a suitable choice of the interaction type and the normalization of the coupling constant by the unit of length $m^{-1} \sim (500\ \mathrm{MeV})^{-1} \sim 0.4y$). Considering that baryons are the composite system of urbaryons and are represented by (L) where L is the total (internal) orbital angular momentum, then the above mentioned characteristics can be formulated as follows: $g^2_{(L)+\mathrm{meson}=(L')}/4\pi \overbrace{\sim}^{(k^2/m^2<1)} \delta_{LL'} + \epsilon(k/m, L \rightleftharpoons L')$, $\epsilon(k/m, 0 \rightleftharpoons L) \sim [(1/2L-1)!^2 (k/m)^{2L}$ for $L = 1$ and 2, $g^2/4\pi \cdot F^2 (k^2) \overbrace{\sim}^{(k \ll m)} \{\exp(-k^2/m'^2)\}^2$ $m' \sim 500$ MeV $\sim$ m, where g, $F(k^2)$ and k are coupling constant, form factor and the momentum of meson (in cms) for the decay processes respectively. On the basis of these results, the baryon-excitation in the high energy nuclear reaction is briefly considered. (auth)

25284 QUARK MODEL AND HIGH ENERGY SCATTERING. Bando, Masako (Kyoto Univ.); Takada, Yoshio. Progr. Theoret. Phys. (Kyoto), 37: 128-42(Jan. 1967).

The shrinkage of the diffraction peak in high energy elastic scattering is treated by assuming the "additivity assumption". It is shown that the different behavior of the shrinkage for various processes could be understood if it is assumed that the scattering amplitude for the quark and its antiquark is different from that for the quark and quark. Also other processes such as charge exchange processes, backward scattering or quasi-two-body processes are treated qualitatively. (auth)

25285 REFLECTION OF ELECTRONS BY STANDING LIGHT WAVES: A SIMPLE THEORETICAL TREATMENT. Bartell, L. S. (Univ. of Michigan, Ann Arbor). J. Appl. Phys., 38: 1561-6(Mar. 15, 1967).

The reflection of electrons by standing light waves, i.e., the stimulated Compton scattering proposed by Kapitza and Dirac, is treated by applying the Born approximation. The probability that an electron will be reflected is derived, for light waves that are not too intense, as a function of the electron beam orientation and of the coherence properties of the light waves. It is shown, among other things, that the original formula of Kapitza and Dirac is not directly applicable to representative studies using lasers. More general formulas are given along with a discussion intended to serve as a practical guide in the design of experiments. (auth)

25286 CHIRAL DYNAMICS. Schwinger, J. (Harvard Univ., Cambridge, Mass.). Phys. Lett., 24B: 473-6(May 1, 1967).

The cumbersome operator techniques and weak interaction orientation of current algebra are replaced by a non-operator method based on strong interaction phenomenology. Some new results include alternative possibilities of $\pi\pi$ scattering lengths and a treatment of ρ and A_1 decay widths that supports the interpretation of A_1 as the axial partner of ρ. (auth)

25287 DYNAMICS OF ELEMENTARY PARTICLES AND THE PION–NUCLEON INTERACTION. COURSE A. Lectures Given at the Niels Bohr Institute and NORDITA, Copenhagen by J. Hamilton. Copenhagen, Nordisk Institut for Teoretisk Atomfysik, 1966. 233p.

The processes discussed are $\pi + \pi \rightarrow \pi + \pi$, $\pi + N \rightarrow \pi + N$, $N + N \rightarrow N + N$, and similar processes in which a γ-ray replaces one pion. The basis of the dynamical theory is considered, not to so deep a level as axiomatic field theory, but to one sufficiently deep to give confidence in the reliability of the theory. Forward and near forward dispersion relations are dealt with, and some applications to the pion-nucleon system are shown. Also the application of the Mandelstam representation is treated. (DENM)

Strong (Baryon No. = 0)

Refer also to abstracts 25306, 25315, and 25317.

25288 BOUNDS ON THE ENERGY DEPENDENCE OF PHASE SHIFTS FROM ANALYTICITY AND UNITARITY. Bonnier, B.; Vinh Mau, R. (Faculte des Sciences, Paris. Faculte des Sciences, Orsay, France). Phys. Lett., 24B: 477-9(May 1, 1967).

A lower limit for the derivative of the phase shifts with respect to energy is derived just from the results of axiomatic field theory. As an application, a lower bound for the $\pi^0\pi^0$ scattering length is found. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 24904.

25289 (HEP-67-2) EVIDENCE FOR AN S = +1, I = 0 RESONANCE IN THE K^+–NUCLEON SYSTEM. Carter, A. A. (Cambridge Univ. (England). Cavendish Lab.). [1966]. 10p. Dep.

The phase of the K^+-nucleon forward scattering amplitude is evaluated from dispersion relations. A qualitative difference is

found between the I = 0 and I = 1 states. With assumptions for the background contributions to the amplitude, evidence is presented for an S = +1, I = 0 resonance. (auth)

25290 (ISS-67/6) CHIRAL ALGEBRA CONDITIONS ON πN AMPLITUDES. Maiani, L.; Preparata, G. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Mar. 1, 1967. 12p. (In Italian). Dep.

It is shown that the local U(2) ⊗ U(2) chiral algebra and PCAC do not give any other sum rule for πN amplitudes apart from the Adler–Weisberger relation. By considering the commutators of an axial charge with an axial dipole sum rule involving weak axial production of pions is derived, which, approximately evaluated, seems to be consistent with present data. (auth)

25291 APPLICATION OF THE NONLOCAL EXCHANGE MODEL TO THE ANALYSIS OF INELASTIC π⁻p INTERACTIONS. Kuchin, I. A.; Toleubaeva, A. S.; Usik, P. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz., 5: 877-83(Apr. 1967). (In Russian).

The calculated and experimental data for a single meson generation are compared in the range p = 1.6 to 4 GeV/c. The one-pion-exchange graph without "an exitation" of nucleon is shown to give the main contribution to inelastic π⁻p interaction. (auth)

25292 INELASTIC π⁺p-INTERACTION AT HIGH ENERGIES AND THE STATISTICAL MODEL FOR THE MULTIPLE PARTICLE PRODUCTION. Zinov'ev, G. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 5: 884-6(Apr. 1967). (In Russian).

The inelastic π⁺p-interaction in the energy interval 1–4 GeV is considered within the framework of the Fermi statistical model of the multiple particle production taking as the intermediate states the known baryon and meson resonances. The results obtained are compared with the experimental data. (auth)

25293 BARYON MASS SPLITTING IN A BOSON–FERMION MODEL. Lichtenberg, D. B. (Indiana Univ., Bloomington); Tassie, L. J. Phys. Rev., 155: 1601-6(Mar. 25, 1967).

A model is proposed in which a baryon consists of a boson and fermion deeply bound in a potential. The fermion can be regarded as a quark and the boson as a bound state of two quarks. In the model, the mass splitting of the different isospin multiplets among the baryons arises partly from mass splittings within the boson and fermion multiplets and partly from a symmetry-breaking interaction. The isospin-conserving mass splittings within the boson and fermion multiplets, as well as the symmetry-breaking interaction, are assumed to be proportional to the hypercharge. Under the assumption that these mass splittings and symmetry-breaking interactions are small, it is found that the seven baryon mass splittings which conserve isospin are given in terms of four parameters, and that the Gell-Mann–Okubo mass formula holds. Some effects of representation mixing are considered. (auth)

25294 BRANCHING RATIOS FOR $Y_1^*(1755)$. Uhlig, R. P. (Univ. of Maryland, College Park); Charlton, G. R.; Condon, P. E.; Glasser, R. G.; Yodh, G. B.; Seeman, N. Phys. Rev., 155: 1448-55(Mar. 25, 1967). (ORO–2504-93).

A study of the reactions $K^-p \to \Lambda\pi^0$, $\bar{K}N$, $\Sigma^\pm\pi^\mp$, $Y_1^*(1385)^\pm\pi^\mp$, and $Y_0^*(1520)\,\pi^0$ was made and the fraction proceeding through the formation of $Y_1^*(1755)$ estimated. The total $Y_1^*(1755)$ resonant cross section is found to be 12.5 ± 1.2 mb and the resonant cross sections into $\Lambda\pi^0$, $\bar{K}N$, $Y_1^*(1385)\pi$, $Y_0^*(1520)\pi^0$, and $\Sigma^\pm\pi^\mp$ are 2.2 ± 0.17, 6.7 ± 1.0, 1.7 ± 0.6, 1.85 ± 0.22, and <0.5 mb. On the basis of these results it is concluded that $Y_1^*(1755)$ cannot be a member of {10}, {10}*, and {27} SU(3) multiplets. The results are consistent with assigning $Y_1^*(1755)$ to an {8} with a mixing parameter α such that $-0.3 < \alpha < -0.1$. (auth)

25295 ALGEBRA OF CURRENTS AND THE VECTOR-MESON–BARYON COUPLING CONSTANTS IN BROKEN SU(3). Lai, C. S. (Indiana Univ., Bloomington). Phys. Rev., 155: 1562-5(Mar. 25, 1967).

Employing the method of current algebra and a hypothesis of partially conserved tensor current, the renormalization effects on the vector-meson–baryon coupling constants, due to the first-order SU(3) breaking, are studied. It is found that the sum rules within the couplings of one vector meson with baryons are the same as those found in the SU(3) limit, and that the renormalization effects are present only when the coupling of one vector meson is compared with the couplings of different vector mesons. With the use of ω-φ mixing with the mixing angle $\theta = \tan^{-1}(\sqrt{1/2})$, the ρ and ω couplings have the same amount of renormalization effects. (auth)

25296 MODEL FOR LOW-ENERGY MESON–BARYON SCATTERING. Goldstein, Gary R. (Univ. of Chicago. Argonne National Lab., Ill.); Wali, Kameshwar C. Phys. Rev., 155: 1762-72 (Mar. 25, 1967).

A model for low-energy meson-baryon scattering within the framework of U(6,6) symmetry is studied. The effective U(6,6)-symmetric terms are treated as background terms representing distant singularities. These are supplemented by the appropriate one-particle exchange contributions. The model is used to calculate the real parts of the S, P, and D partial-wave amplitudes in the low-energy region of πN and KN elastic scattering. It is found that the results are in reasonably good agreement with the experimental information in T = 3/2 and T = 1/2 πN and in T = 1 KN scattering. However, the model predicts large S-wave scattering in the T = 0 KN channel. (auth)

25297 DETERMINATION OF THE S-WAVE π-π AMPLITUDE NEAR THE ρ PEAK FROM THE REACTION $\pi^- + p \to \pi^+ + \pi^- + n$. Bander, Myron; Shaw, Gordon L. (Univ. of California, Irvine). Phys. Rev., 155: 1675-7(Mar. 25, 1967).

A fit to recent extensive data for the reaction $\pi^- + p \to \pi^+ + \pi^- + n$ at incident π^- momentum ~4 BeV/c and final two-pion center-of-mass energy $m_{\pi\pi} \sim m_\rho$ was made. The peripheral model with absorption was used in the fit. The asymmetry in the final two-pion distribution θ_π gives a quantitative determination of the π-π, S-wave, I = 0 scattering amplitude. A constant phase shift of ~+60° gives as good a fit to the data as a resonance ϵ^0 (at 730 MeV with a width of 90 MeV), proposed by Durand and Chiu. A negative phase shift of ~−60° is ruled out by examining the distribution in θ_π as a function of $m_{\pi\pi}$. (auth)

25298 BACKWARD K⁻–p SCATTERING AT 1 TO 2 GeV/c AND RESONANT-STATE Y*'s. Minami, Shigeo (Osaka City Univ.). Phys. Rev., 155: 1678-84(Mar. 25, 1967).

Backward K⁻–p scattering at 1–2 GeV/c is described in terms of the resonance amplitudes due to the $Y_1^*(1765)$, $Y_0^*(1815)$, $Y_1^*(1915)$, $Y_1^*(2040)$, $Y_0^*(2100)$, and $Y_1^*(2260)$. Structure of the $d\sigma/d\Omega$ (180°) for K⁻–p elastic scattering is predicted and the differential cross sections in the backward direction are estimated. It is shown that the experimental results for backward K⁻–p charge-exchange scattering at 1.2–1.7 GeV/c can be explained fairly well by the effects of the Y*'s. Polarization of recoil nucleons in both the $K^- + p \to K^- + p$ and the $K^- + p \to \bar{K}^0 + n$ reactions is predicted by taking into account the effects of the resonant states. (auth)

25299 SPIN-ROTATION PARAMETERS AND PHASE-SHIFT AMBIGUITIES IN π–N SCATTERING. Roper, L. David (Kentucky Southern Coll., Louisville); Bailey, David S. Contract W-7405-eng-48. Phys. Rev., 155: 1744-9(Mar. 25, 1967). (UCRL-70291).

It is shown that there are three phase-shift ambiguities that can occur when not all possible observables are available for the phase-shift analysis at a given energy in spin-0–spin-1/2 scattering. Two of the ambiguities, change of sign of the phases and exchange of opposite-parity phases, have been recognized for some time. The third ambiguity, which is the combination of the first two, can be resolved only by measurement of the spin-rotation parameter. (auth)

25300 TWO-CHANNEL MODEL OF P_{11} π–N PARTIAL-WAVE AMPLITUDE. Ball, James S. (Univ. of California, Los Angeles); Shaw, Gordon L.; Wong, David Y. Phys. Rev., 155: 1725-7 (Mar. 25, 1967).

A simple two-channel model of the P_{11} π–N channel and a phenomenological second channel, the σ-N, is constructed. It is shown that this model reproduces the detailed structure of the π–N phase shift and produces the nucleon pole as a dynamical bound state with the proper residue. On the basis of this model it is argued that the forces required in the second channel are comparable to those in the π–N channel, and a significant portion of the binding of the nucleon is produced by the σ–N channel. Finally, it is observed that the Roper resonance (600 MeV) corresponds to a pole in the S matrix, and should be fitted into an SU_3 multiplet. (auth)

25301 REGGE POLES IN RESONANCE PRODUCTION. Thews, Robert L. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., 155: 1624-45(Mar. 25, 1967). (MIT–2098-261).

The theory of Regge trajectory exchange is applied to the high-energy production of meson and baryon resonances. The helicity representation is used for the production amplitudes. The predictions are compared with experimental data on production of the N*(1238) nucleon resonance by pions and kaons, and also the production of the f^0 and ρ mesons by pions. The energy dependence of the differential cross sections is found to be consistent with the Regge-pole exchange model. Values for the ρ, A_2, and π trajectories are determined. The ρ and A_2 values are compared with those determined by analysis of elastic and charge-exchange scattering data. The π trajectory values have not been determined in other reactions, but they are consistent with the known general properties of Regge trajectories. The spin density matrix elements are

not strongly restricted by the theory, but the predictions that can be made are also consistent with experiment. (auth)

25302 S-WAVE PSEUDOSCALAR-MESON–BARYON SCATTERING IN A SIMPLE MODEL WITH BROKEN SU(3) SYMMETRY. Wyld, H. W. Jr. (Univ. of Illinois, Urbana). Phys. Rev., 155: 1649-62(Mar. 25, 1967).

A model of S-wave pseudoscalar-meson–baryon scattering is studied in which the force is due to vector-meson exchange. The potential is approximated by a static Yukawa potential and the kinematics is simplified. The actual physical masses of the particles are used so that SU(3) symmetry is broken. The resulting problem reduces to a set of coupled-channel Schrödinger equations which are solved exactly on a computer. The K matrix and the eigenphases are calculated. Several examples of virtual bound-state resonances are found. The model yields a $Y_0^*(1405)$ as a virtual bound state of $\bar{K}N$ and an $N_{\frac{1}{2}}^*(1570)$ as a virtual bound state of $K\Sigma$. (auth)

25303 OFF-SHELL PION–NUCLEON SCATTERING. II. Thiebaux, M. L. Jr. (Univ. of Massachusetts, Amherst). Phys. Rev., 155: 1707-11(Mar. 25, 1967).

In an earlier paper, expressions for pionic form factors were derived in an off-shell treatment of pion–nucleon scattering. The development is improved and numerical bounds are estimated for the πNN and $\pi NN^*(1238)$ pionic form factors which are found to deviate from unity by less than 1% and 0.1%, respectively, when the invariant square of the off-shell pion 4-momentum is varied between 0 and m_π^2. (auth)

25304 DYNAMICAL MODELS LEADING TO LIE GROUPS FOR ISOBARIC STATES. Fairlie, D. B. (Univ. of Washington, Seattle. Univ. of Durham, Eng.). Phys. Rev., 155: 1694-8 (Mar. 25, 1967).

The equations of strong-coupling theory and its generalizations to noninvariance groups are expressed in terms of the search for positive eigenvectors of the crossing matrices for various scattering processes showing the same intermediate quantum numbers. It is shown that the same baryon isobars which give a consistent solution of these models for pion-baryon scattering also appear consistently in meson-nucleon scattering, with similar coupling strengths. The equivalence of these models to various bootstrap requirements is demonstrated. (auth)

25305 REGGE CUTS AND π-p TOTAL CROSS SECTIONS. Pursey, D. L.; Sertorio, L. (Ames Lab., Iowa). Contract W-7405-eng-82. Phys. Rev., 155: 1591-8(Mar. 25, 1967). (IS-1419).

The possible contribution of a cut in the angular-momentum plane to pion-proton total cross sections is investigated. Forward dispersion relations are used to derive a sum rule. The resulting predictions are compared with experimental data. Several models in which a Regge cut gives a large contribution to the total cross section are found to be indistinguishable in their predictions from the conventional model based on Regge poles. (auth)

25306 APPLICATIONS OF CURRENT-COMMUTATOR SUM RULES. Fuchs, Norman H. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 155: 1785-7(Mar. 25, 1967).

The intimate relationship between current-commutator sum rules and low-energy scattering of mesons and baryons is demonstrated. The various approximations involved in the derivation are separately discussed. Finally, some comments are made on the pion-pion problem and its relation to the question of continuation in mass, which is basic to the hypothesis of partially conserved axial-vector current. (auth)

25307 SIDEWISE DISPERSION RELATIONS AND THE AXIAL-VECTOR COUPLING CONSTANT. Bardakci, K. (Univ. of California, Berkeley). Phys. Rev., 155: 1788-91(Mar. 25, 1967).

The axial-vector renormalization constant is related to low-energy pion-nucleon scattering amplitude by dispersing the axial-vector vertex in the nucleon mass and using the idea of threshold dominance. The low-energy pion-nucleon amplitude, in turn, can be related to the axial-vector renormalization, giving rise to a consistency condition involving g_A/g_V and the pion-nucleon coupling constant. The solution to this consistency condition is in rough agreement with the observed value. (auth)

25308 FERMION REGGE-POLE MODEL FOR THE STRUCTURE OF PION–NUCLEON ELASTIC SCATTERING IN THE BACKWARD HEMISPHERE. Barger, V.; Cline, D. (Univ. of Wisconsin, Madison). Phys. Rev., 155: 1792-1810(Mar. 25, 1967). (COO-881-88).

The $Y = +1$ fermion resonances that show up strongly in total-cross-section data are classified as Regge recurrences on three straight-line trajectories (namely, Δ_δ, N_γ, N_α) in a Chew-Frautschi plot. From extrapolations of the trajectories, resonance doublets are predicted in the vicinity of 2200 MeV (with $J^P = 7/2^-$ and $9/2^+$) and 2630 MeV (with $J^P = 11/2^-$ and $13/2^+$), due to recurrences of the N_γ and N_α trajectories at similar mass values. A model is constructed for π^-p elastic scattering near the backward direction based on interference of the direct-channel resonance amplitude (Δ_δ, N_γ, N_α) with the amplitude due to fermion Regge exchange (Δ_δ) in the crossed channel. The predictions of the model compare favorably with existing data on the energy dependence of the π^-p differential cross section at 180° center-of-mass scattering angle and the general shape of the π^-p angular distributions near 180°. The results confirm the consistency of the Regge-recurrence parity assignments with the scattering data. The resonance elasticities used in the calculations are roughly the same as the elasticities determined from total-cross-section data. The model is extended to π^+p elastic scattering at backward angles. In the π^+p process, the direct-channel Δ_δ resonance contribution alone saturates the experimental differential cross section in the backward cone at momenta below 4 BeV/c. Comparison with the π^+p backward-scattering data gives additional confirmation for the proposed Δ_δ Regge-recurrence parity assignments. In addition, the model supports the existence of an $I = 3/2$ s-wave resonance at 1690 MeV. Finally, the polarization is predicted for $\pi^\pm p$ elastic scattering in the backward cone. (auth)

25309 INFLUENCE OF HIGH $\pi-N$ PARTIAL WAVES ON ENERGY-LEVELS OF π-MESIC ATOMS. Partensky, A.; Ericson, M. (Univ., Lyon). Nucl. Phys., B1: 382-8(1967).

The influence of d- and f-wave $\pi-N$ scattering on the energy-level shifts of π-mesic atoms is estimated. This influence is shown to be negligible with the present precision on the measured shifts but may be observable in the future. (auth)

25310 DYNAMICAL THEORY OF PION–NUCLEON SCATTERING. Igi, Keiji (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 37: 117-27(Jan. 1967).

A general discussion is given for solving the partial wave dispersion relations for pion-nucleon scattering, while keeping the correct asymptotic behavior intact in addition to the analyticity, unitarity, crossing symmetry and correct threshold behavior. A potential is introduced in order to express the effects from distant singularities. High energy effects at low momentum transfer both in the direct and in the crossed channel, can automatically be taken into account if one solves the N/D equations by employing the above potentials in finite strip regions. The strip width may be determined by the subsidiary condition required by the theory itself. An essential difference is found between the $l(\geq 1)$ wave and s-wave problem. (auth)

25311 OMEGA PRODUCTION AND THE GYROMAGNETIC RATIO OF THE QUARKS. Dennery, Ph. (Faculte des Sciences, Orsay, France); Le Yaouanc, A.; Krzywicki, A. Phys. Lett., 24B: 470-2(May 1, 1967).

Using a quark model, a relation between the differential cross sections for the reactions $\pi^- + p \rightarrow \pi^0 + n$ and $\pi^- + p \rightarrow \omega^0 + n$ is obtained, which involves as the only unknown parameter, the isovector part of the gyromagnetic ratio of the quarks. (auth)

25312 MESON BARYON SUM RULES. Tadic, D.; Zovko, N. (Ruder Boskovic Inst., Zagreb. Univ. of Zagreb). Z. Phys., 201: 232-40(1967).

The PCAC consistency condition, the Adler–Weisberger sum rule and the dispersion superconvergent sum rule were saturated with resonance contributions only. Strangeness-changing currents were considered and compared. The results obtained also support PCAC for the strangeness conserving current. While in the πN case PCAC and the Adler–Weisberger sum rule are almost saturated with the famous N_{33}^* resonance only, in the KN case $Y_1^*(1385)$, $Y_0^*(1405)$ and $Y_0^*(1520)$ seem to be sufficient. The superconvergent sum rule works very well in the case of πN scattering, including the contribution of twelve resonances. For KN scattering it can be neither established nor disapproved. (auth)

Strong (Baryon No. ≥ 2)

25313 (BNL-11299) EMPIRICAL FORMULAS FOR PARTICLE PRODUCTION IN P–Be COLLISION BETWEEN 10 AND 35 GeV/c. Sanford, J. R.; Wang, C. L. (Brookhaven National Lab., Upton, N. Y.). Mar. 1, 1967. 30p. Dep. CFSTI.

Empirical formulas which give quantitative representations of the secondary particle production in p–Be reactions based on the characteristics of the experimental data between 10 and 34 GeV/c incident proton momenta are constructed. Except for certain kinematical constraints the approach is therefore purely algebraic rather than physical. It is found that aside from the goodness of fits to the momentum spectrum the most remarkable achievement of the formula obtained is its prediction of the meson (π) multiplicities. (J.F.P.)

25314 (JINR-P02-3188) OBMEN TENZORNYMI MEZONAMI V UPRUGOM NN-RASSEYANII. (Exchange of Tensor Mesons in Elastic NN-Scattering). Azhgirei, L. S.; Chizhikov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1967. 15p. (In Russian). Dep. mn.

The N−N scattering matrix amplitudes for the exchange of tensor ($J = 2^+$) and pseudotensor ($J = 2^-$) mesons are obtained. A partial wave decomposition is made and the expressions for the partial wave amplitudes are given. (auth)

25315 (JINR-P2-3253) DISPERSIONNYE PRAVILA SUMM DLYA NN- I $N\bar{N}$-RASSEYANIYA. (Dispersion Sum Rules for NN- and $N\bar{N}$-Scattering). Pisarenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 13p. (In Russian). Dep.

By help of dispersion sum rules the parameters of the high energy NN- and $N\bar{N}$-scattering are connected with the cross section integrals in the low and middle energy region. (auth)

25316 MONTE CARLO SIMULATION OF A PROTON–PROTON SPIN CORRELATION EXPERIMENT. Bryant, Howard C. (Univ. of New Mexico, Albuquerque); Jarmie, Nelson. Contract W-7405-eng-36. Phys. Rev., 155: 1444-7(Mar. 25, 1967). (LA-DC-8180).

A FORTRAN IV program is described that simulates in detail the results to be expected from a proton−proton spin correlation measurement for various assumed values for the correlation coefficient C_{nn}. The life history of a successful event is described which includes multiple scattering, relativistic, and energy cutoff effects. Plots of many of the more significant variable distributions are presented, and the advantages of the method are discussed. (auth)

25317 HIGH-ENERGY NUCLEON–NUCLEON SCATTERING FROM REGGE POLES. Flores-Maldonado, Victor (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev., 155: 1773-84(Mar. 25, 1967). (UCRL-16918).

A phenomenological study of N-N scattering is made according to the Regge-pole theory. The p-p, $\bar{p}$-p, p-n, and $\bar{p}$-n elastic processes, and p-n and $\bar{p}$-n charge-exchange scattering are considered. The purpose of this work is twofold: first, to see if there is agreement between a simple Regge-pole model and the existing experimental data, such as measurements of α_t, $d\sigma/dt$, polarizations, the ratio of the real to the imaginary part of the amplitude, and other inferences from π-N scattering. Second, if agreement is found, the behavior of the trajectories and residue functions is investigated. It is found that a Regge-pole model which includes the contributions of the trajectories P, P′, ω, ρ, and R can account for the data. The agreement is better above 15 $(GeV)^2$. Below this energy, discrepancies between this model and experimental data begin to be noticed. This happens, in particular, in processes in which ρ and R are the principal contributors. We find that the zero-momentum-transfer data are in good agreement with an ω intercept of 0.5; with P, P′, and ω residues almost equal in value; and with comparatively small ρ and R residues. The study of the data at invariant momentum transfers less than zero indicates that the trajectories are straight lines or have a small curvature. They seem to follow the trend of the Chew-Frautschi diagram. Poor agreement is obtained with trajectories that tend asymptotically to the axis $\alpha = 0$. The residues of the trajectories of even signature, P, P′, and R, behave similarly. They remain greater than or equal to zero, the zero value being attained at the point at which the corresponding trajectory crosses the axis $\alpha = 0$. In contrast, the residues of the trajectories of odd signature, ω and ρ, pass to the negative side of the plane at momentum transfers of about -0.1 $(GeV)^2$. They remain less than or equal to zero, the zero value being attained at the point at which the corresponding trajectory crosses the axis $\alpha = -1$. The physical constraints of unitarity, spin structure, factorization, and the assumption of real analyticity of the residues are imposed. (auth)

25318 ANALYSIS OF THE Λ-N INTERACTION. Bhaduri, R. K.; Nogami, Y.; van Dijk, W. (McMaster Univ., Hamilton, Ont.). Phys. Rev., 155: 1671-5(Mar. 25, 1967).

It is examined whether the recent low-energy Λ-N scattering data of Alexander et al. are compatible with the binding energies of ${}_{\Lambda}H^3$ and ${}_{\Lambda}He^5$, if only central Λ-N forces are assumed. Λ-N and N-N potentials are set up, in the spirit of the Moszkowski-Scott separation method, to fit the low-energy scattering parameters. It is found that although these forces are compatible with the ${}_{\Lambda}H^3$ binding, ${}_{\Lambda}He^5$ is grossly overbound. This is interpreted as an indication for the existence of an appreciable tensor component in the triplet Λ-N potential. (auth)

25319 INELASTIC PROCESS AND THE ONE BOSON EXCHANGE MODEL. 2. Kikugawa, Masayoshi (Hiroshima Univ.); Sawada, Shoji. Progr. Theoret. Phys. (Kyoto), 37: 88-106(Jan. 1967).

The proton-proton scattering and one pion production in proton-proton collision at 0.97 GeV are analyzed in terms of the one-boson-exchange model. The pion production is assumed to proceed through the (3-3) resonance production. The one π, one ρ, one ω and one scalar meson exchange are taken for the elastic proton-proton scattering amplitudes T^0_Λ, and the one π and one ρ exchange for the (3-3) resonance production amplitudes T^0_β. In order to satisfy the unitarity condition these one-boson exchange amplitudes are related with the S matrix by $S = [1 + (i/2)\,T^0/1 - (i/2)\,T^0]$, where T^0 is the matrix formed by T^0_Λ, T^0_β and the elastic nucleon-(3-3) resonance scattering amplitude T^0_ζ as $T^0 = [T^0_\Lambda\ T^0_\beta/T^0_\beta\ T^0_\zeta]$. The matrix element T^0_ζ is taken as free parameters. The observed energy distribution of recoil neutrons in the one pion production process can be successfully reproduced by this model, almost independently of the parameters T^0_ζ. There the pionic form factor is not necessarily required. (auth)

25320 MANDELSTAM BRANCH POINTS AND SCATTERING OF PARTICLES AT HIGH ENERGIES AND LARGE MOMENTUM TRANSFERS. Anselm, A. A.; Dyatlov, I. T. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Lett., 24B: 479-82(May 1, 1967).

An attempt is made to determine the behavior of the elastic cross section at high energy s and large momentum transfer t by considering the contribution of Mandelstam branch points in the complex angular momentum plane. Outside the diffraction cone, but for $|t| \ll s$, the cross section $d\sigma/dt$ decreases exponentially with $\sqrt{-t}$ (which is in qualitative agreement with Orear's formula) and also exhibits oscillations. The possibilities of experimental investigation of these oscillations are discussed. (auth)

25321 VELOCITY-DEPENDENT POTENTIALS AND THE BINDING ENERGY OF THE TRITON. Lovitch, Lionel (Istituto Nazionale di Fisica Nucleare, Pisa, Italy); Rosati, Sergio. Nucl. Phys., B1: 369-81(1967).

Variational Euler-Lagrange equations for a three-particle system in the presence of central, velocity-dependent, two-body potentials are derived for the case of product radial wave functions of the form $g_1(r_1)\ g_2(r_2)\ g_3(r_3)$, where r_1, r_2, and r_3 are the interparticle distances. The resulting equations are solved numerically in an iterative procedure which yields a quite rapid convergence. Accurate values of the three-nucleon binding energy are obtained for a few examples of such potentials and it is found that a velocity-dependent potential which gives a fairly accurate fit to the two-body data also gives quite reasonable results for the bound states of ^3H and ^3He. (auth)

25322 HYPERON–NUCLEON INTERACTIONS AND ASSOCIATE PRODUCTION ON THE DEUTERON. Renard, F. M.; Renard, Y. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys., B1: 389-410(1967).

The knowledge of hyperon-nucleon interactions from final-state interaction processes is emphasized. The general formalism for reactions of the type (γ or π) + deuteron → K + hyperon + nucleon is written in a completely relativistic manner. It allows the precise calculation of the K-meson spectrum which is particularly sensitive to the hyperon-nucleon interaction in low partial waves. The dynamics includes the relativistic impulse approximation with (γ or π) + nucleon → K + hyperon and the n-p-d vertex functions and final state interactions between K-nucleon and hyperon-nucleon (elastic, charge exchange and Σ-Λ conversion); it is shown that high-order corrections may be taken roughly into account with an overall free normalization factor. General expressions for cross sections and partial-wave decomposition are explicitly given. These results apply for Λ-nucleon and Σ-nucleon processes. They are easily extended to the crossed reactions $\bar{K}$ + deuteron → (γ or π) + hyperon + nucleon. (auth)

25323 K^+–DEUTERIUM SCATTERING. Chand, Ramesh (Wayne State Univ., Detroit). Ann. Phys. (N. Y.), 42: 81-96 (Mar. 1967).

In the multiple scattering formalism for KNN system, low-energy K^+−d elastic and inelastic scattering cross sections, as functions of the I = O, s-wave KN scattering length α_0, and the K^+-laboratory-momentum k_L, are calculated. Using the experimental values for the l = 1, s-wave KN scattering parameters, $\alpha_1(0) = -0.29$ F, $r_1 = 0.5$ F, it is found that the limited experimental data on the K^+−d charge-exchange scattering can be explained by $\alpha_0 = -0.11^{+0.06}_{-0.04}$F. It is also observed that, unlike the case for K^+−p scattering, higher partial waves contribute significantly to the K^+−d scattering for K^+-laboratory-momentum around 300 MeV/c or larger. (auth)

25324 THREE-DIMENSIONAL DEUTERON WAVE FUNCTION. Roberts, P. J. (University Coll., Cardiff, Wales). Nucl. Phys., B1: 114-16(1967).

In recent treatments of the bound states of the deuteron by Kawaguchi, an expression was derived for the three-dimensional

momentum space Schrödinger wave function with the central Yukawa potential. Kawaguchi was only able to calculate this wave function by numerical integration, except in the limit of very small relative momentum. An analytical expression is presented for this wave function, valid for all relative momenta. (auth)

25325 LARGE-ANGLE SCATTERING AT VERY HIGH ENERGIES AND UNITARY SYMMETRIES. Kastrup, H. A. (Univ., Bern). Nucl. Phys., B1: 309-16(1967).

Recent experimental results in high-energy large-angle scattering are compared with a statistical soft-meson model combined with unitary symmetries. This model is able to account for a number of observed properties. In particular it follows that all elastic and inelastic cross sections are dominated by an SU_n-invariant exponential factor which leads to the observed universality for SU_2-invariant reactions, but which may be sensitive to symmetry breaking in the case of SU_3. A method for extracting that part of the cross section which should not be sensitive to symmetry breaking is discussed. (auth)

Particle Invariance Principles and Symmetries

General

25326 $O_{3(n-1)}$ AND n-PARTICLE WAVE FUNCTIONS. Surkov, E. L. (Moscow Physical-Technical Inst.). Yadern. Fiz., 5: 908-22(Apr. 1967). (In Russian).

A classification of n-particle states according to a subgroup $O^3 \otimes O_{n-1} \subset O_{3(n-1)}$ is considered. An amount of missing quantum numbers is discussed. For n = 4 it is shown that there is no degeneration at k < 4. For this case important from a practical point of view polynomials with the definite orbital momentum are obtained that transform under irreducible representations of the permutation group for four particles. (auth)

25327 REPRESENTATIONS OF THE N-DIMENSIONAL ROTATION GROUPS. Chan, Shue-kwing; Young, Kiang-chuen (Chu Hai Coll., Hong Kong). Chin. J. Phys. (Taiwan), 4: 60-70(Oct. 1966).

The Cartan canonical form of Lie algebra of rotation groups O(n) is presented. A set of harmonic functions carrying all the irreducible representations of O(n) has been constructed. Two examples are given: 1. R(3), 2. R(4). (auth)

25328 SPACE–TIME AND ORIGIN OF INTERNAL SYMMETRIES. Kursunoglu, Behram (Univ. of Miami, Coral Gables, Fla.); Hurst, C. A. Phys. Rev., 155: 1663-71(Mar. 25, 1967).

The 3-dimensional Lie algebra of ordinary electrodynamics is shown to lead to a theory of relativistic states described in a Lorentz-invariant way by the group U(3,3). The generators are Lorentz-covariant. Some possibilities with regard to introducing new symmetries within the structure of a space-time transformation group are discussed. (auth)

25329 EXPLICIT SOLUTION OF THE SU(3) ⊗ SU(3) ALGEBRA OF CURRENTS. Bincer, Adam M. (Univ. of Wisconsin, Madison). Phys. Rev., 155: 1699-1706(Mar. 25, 1967).

Explicit formulas are given for various matrix elements of the axial-vector current in an arbitrary irreducible representation of the SU(3) ⊗ SU(3) algebra of currents. The formulas express such quantities as the renormalization G_A of the axial-vector coupling constant, the strength G^* of the axial-vector transition between N and N*, the D/F ratio for the axial-vector current between states of the baryon octet, etc., in terms of the pair of integers that specify an irreducible representation of SU(3). (auth)

25330 REALIZATION OF ALGEBRA GENERATORS ON DYNAMICAL SPACES. Simoni, A. (Univ., Naples); Vitale, B. Nuovo Cim. (10), 48A: 584-6(Mar. 21, 1967).

It is shown that one can obtain a general prescription for generating a family of realizations of SU(n) on a given space S, once a realization is known, each realization being defined by an arbitrary function α (K_i) of the Casimir operators of SU(n). Only the case of SU(2) is discussed. (J.F.P.)

25331 EIGHT DIMENSIONAL ORTHOGONAL GROUP O(8) AND INTERNAL SYMMETRY. Fairbairn, W. M. (Univ. of Lancaster, Eng.). Nucl. Phys., B1: 127-38(1967).

The possibility that the internal symmetry associated with elementary particles is greater than that of the eightfold way is discussed. It is demonstrated explicitly how the use of the eight dimensional rotation group SO(8) can allow only the triality zero representations of SU(3). By the extension to the full orthogonal group O(8) particle-antiparticle conjugation can be defined within the algebra. It is shown that mesons, baryons and antibaryons occur naturally as bases of the irreducible representations of O(8), so that transformations in an eight dimensional Euclidean space form a suitable group for discussing internal symmetry. (auth)

Applications (Electromagnetic and Weak)

25332 CP-VIOLATION IN THE τ-DECAY OF K MESONS. Anisovich, V. V.; Shekhter, V. M. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 5: 855-69(Apr. 1967). (In Russian).

The order of magnitude of CP-violation effects in $K \to 3\pi$ and $K^+ \to \pi^+\pi^0\gamma$ decays is estimated for the various CP-violating interactions. (auth)

25333 CURRENT ALGEBRAS AT INFINITE MOMENTUM. Coester, F.; Roepstorff, G. (Argonne National Lab., Ill.). Phys. Rev., 155: 1583-90(Mar. 25, 1967).

The mathematical properties of the "infinite-momentum limit" of current-density operators are examined. Free-field currents are examined for heuristic purposes. For physical particles the restrictions of the current-density operators are restricted to the one-particle subspace. The existence of an operator limit is demonstrated for scalars, vectors, and antisymmetric tensors. The limit vanishes for scalars and, except in special cases, diverges for higher tensors. The kernels of the limit operators are obtained explicitly as functions of the same invariant form factors that determine the kernels of the original current densities. Commutation relations for the integrated currents are dynamical hypotheses. "Local" commutation relations for the densities at infinite momentum are incompatible with the assumption that the spins are bounded in the one-particle subspace. (auth)

25334 MESON DECAYS IN BROKEN SU(3) AND CURRENT COMMUTATION RELATIONS. Biswas, S. N.; Patil, S. H. (Univ. of California, Los Angeles). Phys. Rev., 155: 1599-1601 (Mar. 25, 1967).

Assuming that the symmetry-breaking Hamiltonian is given by the space integral of the eighth component of the scalar-quark current density, the first-order renormalization of the vector and tensor meson couplings are calculated in the formalism of the algebra of currents. The results are compared with experimental widths and the agreement is found to be good. (auth)

25335 ELECTROMAGNETIC FIELD GEOMETRIZATION AND VIOLATION OF CP-INVARIANCE. Arbuzov, B. A.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 52: 1092-1105(1967). (In Russian).

A geometric interpretation of the interaction, previously suggested, which violates CP-invariance is proposed. A space with absolute parallelism and a Minkowsky metrics and which possesses torsion is considered. It is shown that this type of space is defined by an antisymmetric second rank tensor which can be related to the electromagnetic field tensor. Simple geometric considerations lead to equations which generalize the Maxwell equations. It is shown that in such a space a spinor particle necessarily has an interaction which violates CP-invariance. (auth)

25336 SUM RULES FOR MESONS. I. THE EXISTENCE OF OPPOSITE PARITY STATES. Geffen, D. A. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1371. Ann. Phys. N. Y.), 42: 1-22(Mar. 1967).

By investigating matrix elements of current commutation rules taken between the vacuum and one-meson states (0^-, 1^-), the need for opposite-parity meson states (0^+, 1^+) is shown even in the presence of SU(3) × SU(3) symmetry-breaking effects. Sum rules for these 0^+ and 1^+ states are obtained under the assumption that they appear as resonances and under the assumption that they appear as an enhancement in the scattering amplitude near threshold. The results indicate that these opposite parity states appear either as threshold-scattering enhancements or as resonances close to threshold. When the sum rules are used to calculate the contributions from the 0^+ and 1^+ intermediate states to the meson–meson forward-scattering sum rules, i.e., πK and $\pi\rho$ scattering, it is found that these contributions completely saturate these sum rules. (auth)

Applications (Strong)

25337 EXISTENCE OF SOME BARYON AND MESON UNITARY MULTIPLETS. Enkovski, L.; Kukhtin, V. V.; Nguyen Thi Hong (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 5: 891-4(Apr. 1967). (In Russian).

The possibility is considered that there exist unitary octet, decuplet and singlet of baryon resonances with spin and parity $\frac{1}{2}^+$, $\frac{1}{2}^+$ and $\frac{1}{2}^-$ respectively, and nonet of meson 1+ resonances. Re-

lations between the probabilities of the decays $^5/_2^+ \rightarrow {}^1/_2^+ + 0^-$, $^7/_2^+ \rightarrow {}^1/_2^+ + 0^-$, $^1/_2^- \rightarrow {}^1/_2^+ + 0^-$ and $1^- \rightarrow 0^- + \gamma$ are obtained. (auth)

25338 GAUGE INVARIANCE OF VECTOR MESONS. Castell, L. (Univ. of Kent, Canterbury, Eng. Trinity Coll., Dublin). Z. Naturforsch., 21a: 2110-11(Dec. 1966).

It is found that the unitary representations of the group SO(4,2), to which belong the tensors of rank 1, describe a vector meson and a scalar field with arbitrary mass. A certain class of these representations admits gauge transformations, and therefore describes (in the free field case) only vector mesons. Moreover only this class contains also unitary representations which belong to mass m = 0, that is, the electromagnetic field. The origin of the gauge transformations of the vector potentials has therefore to be explained by the special structure of this class of irreducible unitary representations. Primarily gauge transformations do not depend on the condition of vanishing mass. (J.F.P.)

Quantum Field Theories

25339 (JINR-P02-3085) K POSTROENIYU AKSIOMATICHESKOI TEORII NEPERENORMIRUEMYKH VZAIMODEISTVII. I. NEPERENORMIRUEMYE POLYA KAK ANALITICHESKIE FUNKTSIONALY. (On the Construction of an Axiomatic Theory of Nonrenormalized Interactions. I. Nonrenormalized Fields as Analytical Functionals). Khoruzhii, S. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 23p. (In Russian). Dep. mn.

Formalism of the Wightman axiomatic approach is formulated for the case of nonrenormalized interactions. Various criteria of nonrenormalizability of the theory are investigated. A weakened locality condition, which is fulfilled in nonrenormalized theories, is found and analyzed. (auth)

25340 (JINR-P02-3086) K POSTROENIYU AKSIOMATICHESKOI TEORII NEPERENORMIRUEMYKH VZAIMODEISTVII. II. SUSHCHESTVOVANIE MATRITSY RASSEYANIYA. (On the Construction of an Axiomatic Theory of Nonrenormalized Interactions. II. The Existence of the Scattering Matrix). Khoruzhii, S. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 16p. (In Russian). Dep. mn.

In the framework of the Wightman approach in the theory of nonrenormalized interactions a strong asymptotic Haag-Ruel condition and the existence of the scattering matrix are proved. (auth)

25341 (JINR-P2-3223) SISTEMA S GAMIL'TONIANOM V VIDE ZAVISYASHCHEI OT VREMENI KVADRATICHNOI FORMY OT $\hat{x}$ I $\hat{p}$. (A System With a Hamiltonian as a Time-Dependent Quadratic Form of $\hat{x}$ and $\hat{p}$). Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 20p. (In Russian). Dep.

The solution of the Schrödinger equation is expressed algebraically through the solution of the classical Hamiltonian equations in the case when the Hamiltonian is a quadratic form of coordinates and momenta, and the coefficients of this form depend arbitrarily on time. For such a system the Fock representation is introduced. The results obtained are useful for the quantum field theory formulation in an arbitrary space–time. (auth)

25342 QUANTIZATION OF RELATIVISTIC SCHROEDINGER EQUATIONS FOR ARBITRARY SPIN. Mathews, P. M. (Univ. of Madras). Phys. Rev., 155: 1415-20(Mar. 25, 1967).

It is shown that a recently derived relativistic Schrödinger equation for free particles of arbitrary spin can be consistently quantized in the case of half-integer spins (but not for integer spins) by invoking the microcausality condition and using the role of certain expectation values of the c-number theory as generators of transformations of the Poincaré group in the q-number theory. The correct type of statistics (Fermi-Dirac) for half-integer-spin particles is obtained as a consequence of the theory. The way to handle the integer-spin case is indicated, but details are left for future presentation. (auth)

25343 THEOREM CONCERNING GAUGE INVARIANCE IN QUANTUM ELECTRODYNAMICS. Bialynicki-Birula, I. (Warsaw Univ.). Phys. Rev., 155: 1414(Mar. 25, 1967).

It is pointed out that the theorem on gauge invariance of transition amplitudes in quantum electrodynamics given by Feynman and used by many others is incorrect. The invariance of physical scattering amplitudes under the gauge transformations of the photon propagator is briefly discussed. (auth)

25344 SYMMETRY BREAKING IN NON-ABELIAN GAUGE THEORIES. Kibble, T. W. B. (Imperial Coll. of Science and Technology, London). Phys. Rev., 155: 1554-61(Mar. 25, 1967).

According to the Goldstone theorem, any manifestly covariant broken-symmetry theory must exhibit massless particles. However, it is known from previous work that such particles need not appear in a relativistic theory such as radiation-gauge electrodynamics, which lacks manifest covariance. Higgs has shown how the massless Goldstone particles may be eliminated from a theory with broken U(1) symmetry by coupling in the electromagnetic field. The analogous problem is discussed for the case of broken non-Abelian gauge symmetries. In particular, a model is exhibited which shows how the number of massless particles in a theory of this type is determined, and the possibility of having a broken non-Abelian gauge symmetry with no massless particles whatever is established. A secondary purpose is to investigate the relationship between the radiation-gauge and Lorentz-gauge formalisms. The Abelian-gauge case is reexamined, in order to show that, contrary to some previous assertions, the Lorentz-gauge formalism, properly handled, is perfectly consistent, and leads to physical conclusions identical with those reached using the radiation gauge. (auth)

25345 AXIOMATIC FORMULATION OF QUANTUM ELECTRODYNAMICS. Skarzhinskii, V. D. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 52: 910-18(1967). (In Russian).

A set of linked equations for the current matrix elements is derived in quantum electrodynamics. The equations do not contain any indeterminate quasilocal terms. The latter could be excluded from the equations by including the "principle of minimal singularity" as one of the basic axioms. Various ways of excluding quasilocal terms and the role of gauge invariance in the procedure are examined. It is shown that the assumptions thus made admit of only one independent interaction constant viz. the electron charge. An iteration solution of the equations obtained results in a renormalized series of perturbation theory. (auth)

25346 LSZ-FORMALISM OF INTERACTIONS IN A SCALAR FIELD. Fraas, Hans (Univ., Wuerzburg, Ger.). Z. Phys., 201: 250-68(1967). (In German).

It is shown, what modifications are necessary to treat external fields within the framework of LSZ-formalism. The modified formalism is applied to scalar pair theory. (auth)

25347 FINITE-PARTICLE REPRESENTATIONS AND STATES OF THE CANONICAL COMMUTATION RELATIONS. Chaiken, Jan M. (Massachusetts Inst. of Tech., Cambridge. Cornell Univ., Ithaca, N. Y.). Ann. Phys. (N. Y.), 42: 23-80(Mar. 1967).

A mathematical analysis is made of the existence of the formal number-of-particles operator $N = \Sigma\ a_k^* a_k$ for a representation of the canonical commutation relations, where a_k is the kth annihilation operator. Using a natural rigorous definition of N as a limit of $\Sigma_{k=1}^{n} a_k^* a_k$ as $n \rightarrow \infty$, it is shown that N exists in uncountably many inequivalent irreducible representations; they are all described here. With an alternative definition of N it is proved that N exists only in the zero-interaction (Fock) representation. A related result shows that every regular state of the Weyl algebra which has a finite number of particles with probability one is given by a density matrix in the zero-interaction representation. (auth)

Scattering Theory

25348 (JINR-P2-3198) K VOPROSU O DISPERSIONNYKH PRAVILAKH SUMM. (To the Problem of Dispersion Sum Rules). Kadyshevskii, V. G.; Mir-Kasimov, R. M.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 11p. (In Russian). Dep.

It is shown that the dispersion sum rules can be used for the mapping of the relations between high energy cross sections into the low energy region. (auth)

25349 (JINR-P4-3209) K VOPROSU O TOZHDESTVENNOSTI CHASTITS V TEORII RASSEYANIYA. (On the Problem of Account of Pauli Principle in the Scattering Theory). Efimenko, T. G.; Zhigunov, V. P.; Zakhar'ev, B. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 16p. (In Russian). Dep.

A new method is suggested, in the framework of the multichannel formalism, to take into account the identity of scattered particles and those in the target. In contrast to the generally accepted method the system of coupled equations is formed not for resolution coefficients of a total wave function but of a function with truncated asymptotics. The problem is reduced then to the solution of a system of nonhomogeneous differential and algebraic equations instead of a system of integral-differential equations, which considerably simplifies the problem. (auth)

25350 DAUGHTER TRAJECTORIES AND UNEQUAL-MASS SCATTERING. Freedman, Daniel Z.; Jones, C. Edward; Wang,

Jiunn-ming (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev., 155: 1645-7(Mar. 25, 1967). (UCRL-17113).

It has recently been demonstrated by Goldberger and Jones (I) and by Freedman and Wang (II) that Regge asymptotic behavior obtains at high energy even in regions in which the crossed-channel $\cos\theta$ variable is constrained by unequal-mass kinematics to remain finite. Approaches I and II differ, however, in other important respects. In this note it is shown that method I can be adapted and used to prove the existence and properties of the Regge daughter trajectories found in II. In this argument, an extra assumption necessary in II is avoided, and the restriction $\alpha(0) < \frac{1}{2}$ found in I is eliminated. (auth)

25351 SOME REMARKS ON THE KINEMATIC SINGULARITIES OF THE HELICITY AMPLITUDES. Lin, Keh Ying (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 155: 1515-17(Mar. 25, 1967).

The question of whether the kinematic singularities at t = 0 of the t-channel helicity amplitudes are relevant to the behavior of the differential cross section at high energy and small momentum transfer has been examined. It is concluded that they can be ignored in the phenomenological analysis of two-particle reactions. (auth)

25352 ANALYTICITY IN MOMENTUM TRANSFER AND SHORT-RANGE INTERACTIONS. Kugler, M. (Rockefeller Univ., New York); Roskies, R. Phys. Rev., 155: 1685-9(Mar. 25, 1967).

Omnes's work on the relation between short-range forces and analyticity in the momentum transfer is reviewed and some corrections pointed out. A simpler and more physical proof of his results is given. (auth)

25353 GENERALIZATION AND SELF-RENORMALIZATION OF THE WELLNER EQUATION. Alexanian, Moorad (Univ. of California, Livermore). Contract W-7405-eng-48. Phys. Rev., 155: 1811-14(Mar. 25, 1967). (UCRL-14969-T).

The technique of improving the Born series for a one-coupling-constant theory is generalized for the case of two or more coupling constants. It is shown that no explicit coupling-constant renormalization is necessary in this scheme, since renormalization is accomplished automatically. (auth)

25354 RESONANCES AND EIGENPHASES OF THE S-MATRIX. Weidenmueller, H. A. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 24B: 441-2(May 1, 1967).

The behavior of the individual eigenphaseshifts of the S-matrix is studied over an isolated resonance and is found to be mainly determined by the background. Only the sum of the eigenphases can tell about the presence of a resonance. (auth)

25355 COULOMB EFFECTS ON THE SINGULARITY AT k = 0 OF THE PARTIAL WAVE AMPLITUDES. Bertero, M.; Viano, G. A. (Univ., Genoa). Nucl. Phys., B1: 317-34(1967).

An analysis is presented of the Coulomb effects on the low-energy behavior of the partial-wave amplitudes when the angular momentum λ is complex and restricted to Re $\lambda \geq 0$; only the repulsive Coulomb potential is considered, The analysis is simplified by means of a function $\hat{Z}(\lambda,k)$ related, when λ is physical, to the Bethe–Landau–Smorodinsky effective-range function, $\hat{Z}(\lambda,k)$ is free of Coulomb singularities and meromorphic in the strip $|\text{Im } k| < \frac{1}{2}m$ (m is the range of the potential acting in addition to the Coulomb interaction) and it can generally be expanded in a power series around k = 0. In such a way the threshold behavior of the real part of the Regge trajectories is easily obtained. The imaginary part and the residue of the Regge trajectories are also analyzed and it is found that their behavior is strongly modified by the Coulomb interaction. (auth)

25356 STATISTICAL POTENTIAL MODEL. Machida, Shigeru (Kyoto Univ.); Namiki, Mikio. Progr. Theoret. Phys. (Kyoto), 37: 107-16(Jan. 1967).

The statistical-potential model for high energy elastic scattering is proposed in order to account for large-angle scattering in a unified framework describing the real part of the forward elastic scattering amplitude. The whole amplitude is considered to be decomposed into two parts: one is the pure imaginary shadow scattering amplitude and the other the statistical potential scattering amplitude. The statistical potential scattering amplitude $T^{(c)}$ is formulated under the assumption that many scattering centers are produced when the central collision occurs, and that the distribution of these scattering centers is determined by a distribution function subject to some statistical law. The amplitude $T^{(c)}$ can be treated in analogy to the theory of neutron scattering by crystal. Some empirical formulas can be reproduced from rather natural assumptions on the correlation function of the above system of scattering centers. (auth)

25357 ASYMPTOTIC METHODS FOR THE INVERSE SCATTERING PROBLEM. Lieberman, Sidney Moses. New York, New York Univ., 1965. 77p.

Thesis.

The inverse scattering problem associated with the one-dimensional reduced wave equation $[d^2u(x,k)/dx^2] + (k^2 - v(x))u(x,k) = 0 - \infty < x < \infty$ is considered. From a knowledge of the reflection coefficient r(k) associated with a wave e^{ikx} incident from the left, one can calculate the potential v(x) by finding a solution to $R(x+t) + K(x,t) + \int_{-\infty}^{\infty} K(x,z)R(z+t)dz = 0$ $t < x$, where $R(x+t) = (1/2\pi) \int_{-\infty}^{\infty} r(k)e^{-ik(x+t)}dk$ and $v(x) = [2dK(x,x)/dx]$. This integral equation is transformed, using the Wiener–Hopf technique, into a new integral equation involving contour integrals in the complex plane, and a method for obtaining v(x) for large x is given. It is then shown that the leading term of the asymptotic expansion for v(x) for large x is determined by the singularities of r(k) and $[1/1 - r(k)r(-k)]$. Several special cases are carried out in detail. (Diss. Abstr.)

Particle Accelerators

25358 (CERN-67-4) AN OBSERVER'S ACCOUNT OF USER RELATIONS IN THE U. S. ACCELERATOR LABORATORIES. Kowarski, L. (European Organization for Nuclear Research, Geneva (Switzerland)). Jan. 1967. 27p. Dep. mn.

A survey of the present state of the accelerator/user relations in the United States, with an emphasis on those features which are likely to determine these relations at the future 200 GeV Laboratory, is presented. (B.G.D.)

25359 (CERN-67-06) PHASE-SPACE TRANSFORMATIONS BY MEANS OF QUADRUPOLE MULTIPLETS. Regenstreif, E. (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 20, 1967. 34p. Dep.

Analytic conditions are formulated for achieving simple phase-space transformations by means of quadrupole multiplets, particularly triplets, quadruplets, quintuplets and sextuplets. This problem is of importance in synchrotron magnet layouts (e.g., long straight sections), in rf separator design (interdeflector optics), in beam transport systems, etc. The general theory is considered. An attempt is made to cast the transfer matrices of quadrupole multiplets in a relatively simple and usable form. Analytic conditions for achieving simple phase shifts are also given. Application to particular structures and optimization problems are thought to form the subject of parallel papers. No use is made of the thin lens approximation; the thick lens approach was applied throughout. (auth)

25360 (INR-750/SLBAL/PL) VYBOR PARAMETROV FOKUSIRUYUSHCHEGO KANALA LINEINOGO PROTONNOGO USKORITELYA V SVERKE. (Choice of Parameters of the Focusing Channel for the Proton Linear Accelerator 10 MeV in Swierk). Sura, Yu. (Institute of Nuclear Research, Warsaw (Poland)). Nov. 1966. 54p. (In Russian). Dep.

The general parameters of the focusing system of the 10 MeV proton linear accelerator in Swierk are determined. The optimum value of Cos μ = 0.45 is found for the length of focusing period equal to 4 periods of acceleration. The tolerances of the parameters of the focusing system are determined. The calculated values of acceptance and emittance are 100 and 28.5 mrad.mm respectively. (auth)

25361 (UCRL-17258) USE OF ALUMINUM COILS INSTEAD OF COPPER COILS IN ACCELERATOR MAGNET SYSTEMS. Green, Michael A. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 24, 1967. Contract W-7405-eng-48. 15p. (CONF-670307-36). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

Use of aluminum windings for the ac injector-synchrotron and dc storage ring magnet systems has been studied. The injector synchrotron is an 18-Hz fast-cycling 8-GeV accelerator that feeds protons to the 200-GeV main ring. The physical properties of aluminum are discussed, as are the extrusion of the conductor and the winding of the coils. Also included is a discussion of cooling-system problems and their solution. Important design conditions for aluminum coils are given. An economic analysis of aluminum- and copper-coiled magnet systems is presented. As an example, the injector-synchrotron magnet system is compared to a dc storage-ring magnet system with the same magnetic characteristics. The optimum coil current density is discussed, as are the effect of gap field, economic life, and core shape on cost and optimum current density. Physical and economic advantages of aluminum coils for magnet systems are presented as are conditions under which the use of aluminum coils should be avoided. (auth)

25362 (UCRL-17269) SECONDARY BEAM MAGNETS FOR THE 200-GeV ACCELERATOR: CONVENTIONAL OR SUPERCONDUCTING? Meuser, Robert B. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 17, 1967. Contract W-7405-eng-48. 9p. (CONF-670307-31). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

To exploit fully the capabilities of the 200-BeV Accelerator, many experimental beams must be set up concurrently, and many magnets will be required. The great stiffness of secondary-particle beams having momenta around 100 GeV/c requires long magnets to provide reasonable focal lengths and deflections. The result is a very expensive system of dc beam-transport magnets, and a large expenditure for electric power. Recent spectacular advances in the technology of superconducting (SC) magnets have led to considering the economics of replacing conventional magnets with equal numbers and kinds of SC magnets. The total capital-plus-operating costs of the two systems are discussed (B.G.D.)

25363 (AD-643981) APPROXIMATE CALCULATION OF THE DYNAMICS OF ELECTRONS IN AN INJECTOR-BUNCHER. Gass, V. F. Translated from Uskor., Mosk. Inzh.-Fiz. Inst., Sb. Statei, No. 5, 45-54(1963). 17p. (FTD-MT-65-488). CFSTI.

The injector-buncher consists of two cylindrical resonators located side-by-side. Oscillations of type E_{010} are excited in the resonators. A cold-cathode (field-emission cathode) is located in the first resonator. A sharp pulse of current occurs during one complete cycle of high-frequency oscillation. The nature of the cold-cathode current under a sinusoidal voltage is shown. It is proven that by using certain assumptions during the solution of the equations of motion of the electrons in the resonators, a qualitative and quantitative study can be made of the bunching properties of the considered device without resorting to numerical integration of the equation of motion. (auth)

25364 (SLAC-Trans-59) PROPOSED NEW TYPES OF CAVITY RESONATOR. Puglisi, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Translated by Benjamin Thayne (Stanford Linear Accelerator Center, Calif.), from report LNF-66/54. 8p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.10 fs, $0.80 mf.

A new type of resonator is proposed, which, while having the same frequency and operating voltage of conventional charged resonators has geometric dimension much smaller. (B.G.D.)

25365 STABILIZATION OF BETATRON OSCILLATIONS. Kulikov, O. F.; Loskutov, Yu. M.; Yarov, A. S. (Moscow State Univ.). Yadern. Fiz., 5: 810-14(Apr. 1967). (In Russian).

The quantization of the oscillatory levels is shown to affect the size of the electron bunch in accelerators and storage rings. This effect can be of great importance for axial oscillations in some energy region. The influence upon the bunch size of the plurality of the electrons and the natural collimations of the synchrotron radiation are considered. (auth)

25366 USE OF PARTICLE CHARGE TRANSFER FOR MULTIPLE ACCELERATION IN A POTENTIAL ELECTRIC FIELD. Vyalov, G. N.; Fiks, M. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk, 89: 437-52(July 1966). (In Russian).

A new field of nuclear research would be opened up, if it were possible to accelerate uranium ions to energies above the Coulomb barrier, that is, to obtain ions with energies on the order of E = 5 to 10 MeV/n (per nucleon). Multiple acceleration of uranium ions to these energies and to higher energies is possible in principle by passing the heavy ion through a condensed target and a gaseous target in succession. The effective ion charge depends on the density of the substance through which the ion beam passes, and increases with increasing density of the substance. Analysis shows that it is possible to accelerate uranium ions to energies of about 10 MeV/n (total energy W equal to about 2.5 GeV) at an accelerating potential of V = 5.4 megavolts by passing the uranium ions through a thin solid target and a gaseous target a total of 50 times. The energy increase per pass is at least 30 MeV. The particle scattering is determined by the injection energy W_0 and the energy increase ΔW per pass. Beam losses due to scattering are substantial only for the first few passes. The charge and energy distributions of the particles in the accelerator are analyzed. (TTT)

25367 LINEAR ELECTRON ACCELERATOR FOR MEDICAL PURPOSES. Telford, W. M. (McGill Univ., Montreal); Crawford, J. E.; Zwick, H. H.; Stephens-Newsham, L. G. J. Can. Ass. Radiol., 28: 278-82(Mar. 1967).

The design of an 8-MeV linear electron accelerator is described. The instrument makes use of an S-band magnetron and has an accelerator tube made up of separate copper discs clamped together to give a vacuum-tight column 240 centimeters long. Microwave pulses are fed into the accelerator and electron currents of up to 65 microamperes have been obtained. For medical purposes, the electrons bombard a gold target to produce bremsstrahlung. The head of the accelerator rotates and is equipped with collimator jaws made of uranium metal. The head is also shielded with uranium. The problem of neutron production by photodisintegration of uranium is discussed. The possibilities of the accelerator as a useful source of neutrons are also considered. (auth)

25368 INTENSITY LIMITATION OF ACCELERATORS. Suzuki, A. (Carnegie Inst. of Tech., Pittsburgh). Nucl. Instrum. Methods, 51: 238-40(May 1967).

The beam intensity of an accelerator is limited by a momentary drop of the accelerating voltage due to a high peak current, as well as by the space charge defocusing effect. The maximum expectable beam current is proportional to the voltage squared. (auth)

25369 USE OF CHEMICALLY DOPED POLYSTYRENE AS A POLARIZED PROTON TARGET MATERIAL. Hwang, C. F. (Northwestern Univ., Evanston, Ill.); Hasher, B. A.; Hill, D. A.; Markley, F. Nucl. Instrum. Methods, 51: 254-6(May 1967).

Dynamic proton polarization of 22% in DPPH-doped polystyrene was obtained at 25 kG and 1.2°K, giving 30% polarization when extrapolated to 1°K. Target capabilities of this material are discussed. (auth)

25370 EVALUATION OF PARTICLE BEAM PHASE SPACE MEASUREMENT TECHNIQUES. van Steenbergen, A. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Nucl. Instrum. Methods, 51: 245-53(May 1967). (BNL-10533).

The determination of particle beam emittance and density distribution in the transverse phase space projection, as encountered for the proton beams at various energy levels in the AGS, is discussed and the various methods are quantitatively compared. It is shown that in general for typical experimentally observed density distributions the different methods will yield similar phase distribution contours. (auth)

25371 FOCUSING DEVICES FOR A POSITRON BEAM AT THE LINEAR ACCELERATOR OF ORSAY. Haissinski, J. (Ecole Normale Superieure, Orsay, France). Nucl. Instrum. Methods, 51: 181-96(May 1967).

A description is given of an efficient focusing device to capture positrons coming out of a converter located at an intermediate point in the wave-guide of a linear accelerator. The main characteristics of the positron source emittance are reviewed. A transfer matrix formalism is set enabling an easy computation of paraxial rays of ultrarelativistic positrons accelerated in a magnetic field which has the same cylindrical symmetry as the accelerating wave guide itself. Magnetic lenses and nonuniform solenoidal fields can be treated by approximating them by piece-wise constant field distributions. Based on this formalism, a computer program can be set to analyse the exact acceptance of the machine, in particular the radial one, so that one can treat positron sources which have non negligible transverse dimensions. The overall analysis enables one to determine the best choice of parameters for such focusing systems which include magnetic lenses and solenoidal fields. (auth)

25372 CALCULATION OF THE EFFECT OF AN EXTENDED FRINGING FIELD IN A MAGNET WITH A HOMOGENEOUS FIELD. Mougey, J. (CEN, Saclay, France). Nucl. Instrum. Methods, 51: 277-84(May 1967). (In French).

The effects of extended fringing fields on focusing properties of magnets with a homogeneous field are calculated under simple assumptions. It can be seen that: a. in the radial plane, the corrections on the first-order terms can be calculated in an analytic way; b. in the transversal plane, several simple formulas are given, which are in good agreement with results obtained by a computer program. (auth)

25373 PULSE GENERATOR FOR A MEGAVOLT TOTAL CHARGING VOLTAGE IN A COMPACT VOLUME. I. THE PULSE GENERATOR. Nicolai, E.; Lange, F. (Institut fuer Biophysik, Berlin). Nucl. Instrum. Methods, 51: 293-8(May 1967). (In German).

After a short description of the principle of a high-voltage impulse generator circuit a report is given about the construction of an impulse generator with a total charging voltage of 1 MV and an impulse energy of 5 kWs. Because of the use of new capacitors it is possible to build the circuit with a very small volume. Therefore we get a specific energy volume from only 2.42 kWs/m^3. The impulse generator circuit is the principal part of the pulsed particle accelerator. (auth)

25374 DEVELOPMENT OF AN FFAG-ELECTRON SYNCHROTRON OF THE RADIAL-SECTOR TYPE (FINAL ENERGY

OF 150 MeV). VI. OPTIMAL NETWORK FOR THE WIDE-BAND TUNING OF ACCELERATOR ELECTRODES FROM GIVEN RELATIVE NETWORK CHARACTERISTICS. Moehl, D. (Freie Univ., Berlin). Nucl. Instrum. Methods, 51: 285-92(May 1967). (In German).

A suitable way (discussed by several authors) in the design of a broad-band acceleration system for a particle accelerator with high pulse repetition rates is to insert a passive matching network between the fixed tuned cavity and the final amplifier. A passive (positive real) matching network with given relative transmission characteristics, which allows a given acceleration voltage to be realised with a minimum of average power absorption of the amplifier from its power supply, is referred to as an optimum network (for the given transmission characteristics). A method to calculate the minimum power for given relative network characteristics is described and the minimum power is determined for the characteristics of three networks discussed in literature (low Q multiple circuit system of bandfilter type, high Q double-tuned bandfilter-system and "wave parameter network" proposed by F. Fiebig). The low Q bandfilter-type networks turn out not to be optimum. The cause for their ineffectiveness is the damping resistor in parallel to the acceleration cavity. Optimum low Q networks with similar relative characteristics are proposed, which are favorable with respect to power consumption up to a factor of 2, requiring one or more additional LC-circuits as compared with non optimum bandfilter networks. (auth)

25375 ACCELERATION OF CHARGED PARTICLES IN MOVING TRAPS PRODUCED BY ELECTROMAGNETIC WAVES. Davydovskii, V. Ya.; Yakushev, E. M. (Inst. of Nuclear Physics, Alma-Ata, USSR). Zh. Eksp. Teor. Fiz., 52: 1068-72(1967). (In Russian).

For a certain interval of initial conditions a plane electromagnetic wave may form a trap. The particle energy in the trap increases with growth of the wave velocity and tends to infinity when the wave velocity approaches the velocity of light in vacuum. (auth)

25376 RECENT DEVELOPMENTS IN THE STUDY OF SOME DIRECT REACTIONS NEAR THE SYNCHROCYCLOTRON AT 157 MeV AT ORSAY. Langevin-Joliot, Helene (Univ., Paris, Orsay, France). Z. Naturforsch., 21a: 1737-43(1966). (In French).

The experimental equipment of the Orsay synchrocyclotron is described. The experimental possibilities seem limited to the two reactions studied, $^{6}Li(p,\gamma)^{7}Be$ and $D(p,\gamma)^{3}He$. The studies on inelastic scattering are developing at Orsay in two different directions. On one hand there is a systematic study of the electric transitions in a series of light and medium nuclei and on the other hand there is a detailed study of the angular distribution and the polarization of neutrons scattered in the case of particular levels. An indication is given of the type of data obtained from both types of studies. Data on moment distribution of nucleons created by (p,2p), (p,d), and (p,γ) reactions and data on nuclear structure obtained from the (p,d) and (p,2p) reactions are outlined. (J.S.R.)

25377 MODE OF ACTION AND CONSTRUCTION OF PROTON SPIRAL LINEAR ACCELERATORS WITH VARIABLE FINAL ENERGY. Daenzer, H.; Herminghaus, H.; Klein, H. (Institut fuer Angewandte Physik, Frankfurt am Main). Z. Naturforsch., 21a: 1761-70(1966). (In German).

The mode of operation of the proton spiral linear accelerator and its principal construction were briefly described and estimations were made on the parallel impedance attainable. It was shown how a variable final energy was produced by sectional construction and how the coolant and the focusing problems can be solved. Two construction examples for continuous and pulsed operation were explained. (tr-auth)

25378 PREPARATION OF THIN OSMIUM TARGETS. Avida, R.; Mustachi, A. (Hebrew Univ., Jerusalem). Nucl. Instrum. Methods, 50: 351-2(1967).

A safe and reliable method is described for the preparation of osmium targets by electrospraying a colloidal suspension of osmium dioxide in ethanol. (auth)

25379 SIMPLIFIED PASSIVE ELEMENT ARC SUPPLY FOR THE DUO-PLASMATRON ION SOURCE. Helmer, R. J.; Jagger, J. W. (Univ. of Texas, Austin). Nucl. Instrum. Methods, 50: 343-5(1967). (ORO-2972-24).

Construction of a duo-plasmatron ion source has prompted consideration of the arc supply from the standpoint of simplicity, reliability and electric efficiency. The latter is of particular importance because of power limitations and the necessity for minimizing dissipation in the accelerator terminal. A power supply having an output impedance characteristic which is substantially resistive can be made with passive elements and operate with less power dissipation than the equivalent physical resistor. (auth)

25380 ^{15}N TARGET FOR ELECTRON SCATTERING. Daily, E. B.; Croissiaux, M. (Institut de Recherches Nucleaires, Strasbourg). Rev. Sci. Instrum., 38: 646-8(May 1967).

A ^{15}N target system was made for high energy electron scattering. The target material was ammonia $^{15}NH_3$ liquefied by dry ice. The target windows were closed with very thin stainless steel foils. (auth)

25381 HIGHLY EFFICIENT, INEXPENSIVE, MEDIUM CURRENT ION SOURCE. Hirsch, Robert L.; Meeks, Gene A. (ITT Farnsworth Research Corp., Fort Wayne). Rev. Sci. Instrum., 38: 621-4(May 1967).

A newly designed ion source has provided deuterium ion currents up to 10 mA at input powers of about 100 W. The device utilizes a diffuse, filament-excited dc discharge produced in the 10^{-3} Torr pressure region and incorporates an ion extractor as a part of the plasma chamber. The extractor and discharge chamber exit aperture form a converging lens that shapes the ions into a small diameter beam, which exits the chamber through a small orifice in the extractor. The combination of low operating pressure and small diameter exit orifice results in low neutral gas leakage. Simplicity of design and operation renders the unit relatively inexpensive to build and maintain. Because the discharge is diffuse, it can be readily scaled up or down in size and modified for the extraction of a variety of beam shapes. (auth)

25382 TRANSPORT OF CHARGED PARTICLE BEAMS. Banford, A. P. New York, Barnes and Noble, Inc., 1966. 239p. $11.75.

The principles and practices of the transport of charged particle beams are reviewed. Topics discussed are: properties of beams; matrix methods; beams delivered by accelerators; magnetic and electric beam bending devices; quadrupole lenses, specialized transport devices; beam design methods; operative beam systems; and installation, commissioning, and operation. Over 400 papers and reports are cited in the text, and a further 300 in the supplementary bibliography. (B.G.D.)

25383 CHARGED PARTICLE EXTRACTING MAGNET FOR AN ACCELERATOR. Lambertson, Glen R. (to U. S. Atomic Energy Commission). U. S. Patent 3,323,088. May 30, 1967.

A magnet particularly designed for extracting a charged particle beam from the beam orbit of a high energy particle accelerator such as a synchrotron is described. A long channel formed from a magnetic material has a longitudinal septum portion disposed immediately adjacent the beam orbit of the accelerator. A magnetic field is produced in the channel transverse to the septum. Beam particles directed into the channel across the thin septum are removed from the accelerator beam orbit and directed at external targets. (AEC)

25384 PROCESS AND APPARATUS FOR PRODUCING PURIFIED FAST PARTICLE BEAMS. Damm, Charles C. (to U. S. Atomic Energy Commission). U. S. Patent 3,319,118. May 9, 1967.

A particle beam filter apparatus arranged to selectively purge low velocity particles from a primary beam of particles of mixed velocities by means of a particle generator which directs a beam of particles of the same velocity as the slow particles to be removed across the primary beam path is described. (AEC)

25385 SINKHROTRONNOE IZLUCHENIE. (Synchrotron Radiation). Sokolov, A. A. (ed.). Moscow, Izdatel'stvo Nauka, 1966. 228p.

Abstracts were prepared for each of the six papers included. (C.E.S.)

25386 SYNCHROTRON RADIATION. Sokolov, A. A.; Ternov, I. M. pp 5-17 of Sinkhrotronnoe Izluchenie. Sokolov, A. A. (ed.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The history of the synchrotron radiation theory is described in some detail. The starting point was given by the fundamental remarks of D. Ivanenko and I. Y. Pomeranchuk about the important part which such radiation will play in accelerating machines. The theory of the synchrotron radiation was amply used in designing the electron accelerators. The theory of the synchrotron radiation has found very important applications in the study of the nonthermal radiation of Galaxies and recently discovered quasistellar objects and other astronomical objects. The synchrotron radiation proved also to be essential in various plasma investigations and quite recently in the construction of some maser-type systems. (auth)

25387 CLASSICAL THEORY OF THE SYNCHROTRON RADIATION. Sokolov, A. A.; Ternov, I. M.; Bagrov, V. G. pp 18-71 of Sinkhrotronnoe Izluchenie. Sokolov, A. A. (ed.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The following problems are treated classically: the emission of

radiation by relativistic electrons moving in the constant and homogeneous magnetic fields, the spectral and angular distribution of the radiation intensity, the polarization properties of the synchrotron radiation, the asymptotic approximation for high index Bessel functions, the approximate expression for the radiation intensity in the ultrarelativistic case, the momentary angular distribution of the radiation intensity and the coherence problem for the radiation emitted by many electrons, the classical theory of the synchrotron and betatron oscillations taking into account the radiation, and the clock paradox for the charged particles moving in the magnetic field. (auth)

25388 QUANTUM THEORY OF RADIATION OF RELATIVISTIC ELECTRONS MOVING IN THE CONSTANT AND HOMOGENEOUS FIELD. Sokolov, A. A.; Ternov, I. M.; Bagrov, V. G.; Rzaev, R. A. pp 72-151 of Sinkhrotronnoe Izluchenie. Sokolov, A. A. (ed.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The following problems are treated quantum-mechanically: the description of the spin (polarization) properties of an electron, the wave functions of an electron in a constant and homogeneous field, the spontaneous radiation with account of the polarization effects, the intensity of the synchrotron radiation, the radiation of the longitudinally polarized electrons, the radiation of the unpolarized electrons, the radiation of the unpolarized electrons, the radiation of the transversally polarized electrons, and the fluctuation excitation of the radial betatron oscillations. (auth)

25389 INFLUENCE OF THE SYNCHROTRON RADIATION ON THE MOTION OF ELECTRONS IN AN INHOMOGENEOUS MAGNETIC FIELD. Sokolov, A. A.; Ternov, I. M.; Zhukov, M. V.; Leventuev, V. P. pp 152-81 of Sinkhrotronnoe Izluchenie. Sokolov, A. A. (ed.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The following problems are treated quantum mechanically: the global formulas for the transition probabilities, the electron motion in the axially symmetric magnetic field, the general formulas for the transition probabilities due to the synchrotron radiation, and the influence of the synchrotron radiation on the energy losses and on the betatron oscillations. (auth)

25390 SEMICLASSICAL THEORY OF THE QUANTUM FLUCTUATION FORCES. Sokolov, A. A.; Ternov, I. M.; Loskutov, Yu. M. pp 182-94 of Sinkhrotronnoe Izluchenie. Sokolov, A. A. (ed.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The following problems are treated: the influence of the fluctuation forces on the synchrotron radiation and on the betatron and synchrotron oscillations and the discussion of the foundations of the quantum theory in connection with the theory of fluctuations. (auth)

25391 EXPERIMENTAL INVESTIGATION OF THE RADIATION AND MOVEMENT OF ELECTRONS IN THE SYNCHROTRONS. Korolev, F. A.; Kulikov, O. F. pp 195-226 of Sinkhrotronnoe Izluchenie. Sokolov, A. A. (ed.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The results of the experimental investigations of synchrotron radiation are presented. These investigations have been carried out on 280- and 680-MeV synchrotrons. Polarization properties, angular distribution and some spectral-polarization characteristics of the radiation were investigated. The variation regularities of amplitudes of synchrotron and betatron oscillations of an electron cluster were studied by a high-speed photography method. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 25183, 25192, 25203, and 25615.

25392 (BNL–50004(Add.)) PROCEEDINGS OF THE NATIONAL TOPICAL MEETING ON REACTOR PHYSICS IN THE RESONANCE AND THERMAL REGIONS: AN ADDENDUM, FEBRUARY 7–9, 1966. Chernick, Jack (ed.) (Brookhaven National Lab., Upton, N. Y.). Oct. 1966. Contract AT-30-2-GEN-16. 46p. (CONF-660204(Add.)). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From American Nuclear Society Meeting, San Diego, Calif.

Eleven papers on neutron thermalization (7) and neutron resonance absorption (4) are outlined and are briefly discussed. (D.C.W.)

25393 (EANDC-(US)–58(U)) COMPILATION OF NEUTRON REACTION AND TOTAL CROSS SECTIONS AT 14 MeV. Mathur, Suresh C.; Ashe, John B.; Morgan, Ira L. (Texas Nuclear Corp., Austin). June 26, 1963. Contract AF33(616)-8160. 72p.

A compilation of neutron reaction and total cross sections is presented for nuclei with A = 1 to 236. Reaction Q-values; half lives of product nuclei; and the types, energies, and intensities of radiations are also included. 303 references. (D.C.W.)

25394 (GA–7164(Pt.2)) ON STABLE METHODS OF MATRIX FACTORIZATION FOR BLOCK-TRI-DIAGONAL MATRICES. PART 2. APPLICATION TO MULTIGROUP DIFFUSION EQUATIONS. Froehlich, Reimar (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 31, 1966. Contract AT(04-3)-167. 64p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The inhomogeneous multigroup diffusion equations for one, two, and three dimensions are considered in a difference equation formulation. With a proper ordering of the unknowns the systems of linear equations have block-tri-diagonal coefficient matrices — this is demonstrated in several figures. The reconditioning method, also known as stabilized march out technique, is shown to be applicable to these equations in the subcritical case. In the supercritical case necessary and sufficient conditions for the applicability of the reconditioning method are derived. The solution of the homogeneous multigroup diffusion equations can be obtained with fission power or Wielandt iterations, in solving repeatedly inhomogeneous multigroup diffusion equations with the same coefficient matrix but with different inhomogeneous parts. In the case of Wielandt iterations, and especially for the calculation of higher modes, it is shown that the general reconditioning method is applicable in avoiding reconditioning transformations at certain locations. The specialization of the reconditioning method, the forward elimination-backward substitution method, is, in general, not adaptable to the situation. Necessary matrix conditions (nonnegativity criteria) for the subcriticality of the inhomogeneous equations in the case of Wielandt iterations, which are extremely helpful for practical calculations, are derived. These criteria correspond to similar criteria derived for the conventional forward elimination-backward substitution method by E. L. Wachspress. The reconditioning method and its specialization, the conventional forward elimination-backward substitution method, are compared with respect to the necessary number of arithmetical operations and storage requirements. Several realistic problems are considered for one-, two-, and three-dimensional multigroup diffusion problems in the case of fission power and Wielandt iterations. On the basis of this comparison the problem of whether fission power iterations (accelerated by Chebyshev polynomial methods), Wielandt iterations, or the root-finding methods (stabilized march out technique applied to homogeneous eigenvalue problems of the diffusion equation by D. R. Edwards and K. F. Hansen) are most effective for the solution of eigenvalue problems for the homogeneous one-dimensional multigroup diffusion equations are discussed. (B.G.D.)

25395 (LA-DC–8706) STOCHASTIC FORMULATIONS OF NEUTRON TRANSPORT. Bell, George I. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 35p. (CONF-670410–1). Dep. CFSTI.

From American Mathematical Society Meeting, New York.

A review of stochastic neutron transport theory is presented with emphasis on the treatment of neutron transport as a Markov process. Various formulations of stochastic neutron transport theory are discussed, and the formulation of transport theory in terms of the probability generating function and of the lower-order moments of the probability distribution is outlined. (D.C.W.)

25396 (NAA-SR-Memo–12203) ALP–ANISN LIBRARY PROGRAM. Boling, M. A. (Atomics International, Canoga Park, Calif.). Oct. 18, 1966. Contract AT(11-1)-Gen-8. 22p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The computer program ALP, which was written to update the ANISN cross-section library, is described. The program is written in FORTRAN IV for the IBM 7094. A listing of the program is included. (D.C.W.)

25397 (NP–16508) ONE-SPEED TRANSPORT THEORY WITH ANISOTROPIC SCATTERING. APPLICATION TO THE SLAB ALBEDO PROBLEM. PART I. THEORY. Kaper, H. G. (Groningen Rijksuniversiteit (Netherlands). Mathematisch Instituut). July 1966. 76p. (TW–37). Dep. mn.

The method for solving one-speed transport problems with anisotropic scattering in plane geometry as developed by Mika is applied to the slab albedo problem, i.e., the problem of finding the angular density of particles in a bare slab with a monoangular beam of particles incident upon one face. The problem is reduced to determining coefficients in the so-called normal mode expansion. These coefficients are shown to depend upon the solution of a set of nonhomogeneous Fredholm integral equations. (auth)

25398 (UJV–1754) VYPOCET NEUTRONOVYCH TOKU MOMENTOVOU METODOU. (Moments Method Calculation of Neutron Fluxes). Rataj, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1967. 21p. (In Czech).

The moments methods solution of the one-dimensional Boltzmann transport equation in the plane and spherical geometry in the infinite homogeneous space is described. The adjustment of equations to numerical calculation of spatial flux moments and backward reconstruction of flux is included. A description of a code in the ALGOL language and of a sample calculation are also included. (auth)

25399 (ANL-Trans–168) BULLETIN OF THE INFORMATION CENTER ON NUCLEAR DATA (FIRST ISSUE). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Buylleten Informatsionnogo Tsentra po Yadernym Dannym, Atomizdat, Moscow, 1964. 442p. Dep. CFSTI.

Parameters of elementary interactions of neutrons with nuclei are presented, together with reactor constants. The calculation of neutron cross sections by the optical model, using computers is discussed, as is data processing for single-crystal fast-neutron scintillation spectrometry. (D.C.W.)

25400 (UCRL-Trans–10087) CALCULATION OF THE NEUTRON CHARACTERISTICS OF ROCKS. Kozhevnikov, D. A. Translated by Z. F. St-Gallay for Univ. of California Lawrence Radiation Lab., Livermore, from Tr. Mosk. Inst. Neftekhim. Gazov. Prom., No. 41, 54-75(1963). 41p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $4.60 fs, $1.43 mf.

A theoretical analysis of neutron slowing down and thermalization in rocks is presented. A method for the calculation of the neutron age and slowing-down length is described, and some numerical results of calculations of slowing-down lengths in various rocks are given. (D.C.W.)

25401 A TWO-REGION PROBLEM IN TIME-DEPENDENT MONOENERGETIC NEUTRON TRANSPORT THEORY. II. APPLICATIONS. Erdmann, R. C.; Lurie, H. (California Inst. of Tech., Pasadena). Nucl. Sci. Eng., 28: 198-202(May 1967).

Using an exact transport solution, numerical calculations of interface flux and current are made for a plane burst of neutrons introduced at the boundary separating two semi-infinite media. Asymptotic flux expressions for large time at the interface are also presented, and these have the exponential dependence given by diffusion theory. Following the neutron burst, the interface current is found to change directions once, at most. The magnitude of the interface current is shown to depend initially on the difference in scattering cross sections of the half-spaces and asymptotically on the difference in absorption cross sections. In the special case of identical half-spaces, diffusion theory yields a more accurate representation of the flux than does P_1 theory, although for long times both approximate solutions rapidly approach the exact result. (auth)

25402 A TWO-REGION PROBLEM IN TIME-DEPENDENT MONOENERGETIC NEUTRON TRANSPORT THEORY. I. ANALYSIS. Erdmann, R. C.; Lurie, H. (California Inst. of Tech., Pasadena). Nucl. Sci. Eng., 28: 190-7(May 1967).

An exact solution to the monoenergetic Boltzmann equation is obtained for the case of a plane isotropic burst of neutrons introduced at the interface separating two adjacent, dissimilar, semi-infinite media. The method of solution used is to remove the time dependence by a Laplace transformation, solve the transformed equation by the normal mode expansion method, and then invert

to recover the time dependence. The general result is expressed mainly as a sum of definite, multiple integrals. Certain simplifications were possible at the interface, and these are explicitly noted. (auth)

25403 APPLICATIONS OF THE INVARIANT IMBEDDING METHOD TO MONOENERGETIC NEUTRON TRANSPORT THEORY IN SLAB GEOMETRY. Mingle, John O. (Kansas State Univ., Manhattan). Nucl. Sci. Eng., 28: 177-89(May 1967).

The invariant imbedding theory for the monoenergetic neutron transport equation in slab geometry is determined in terms of reflection, transmission, and escape functions. The application of this theory to escape probabilities, blackness coefficients, and critical size determinations is shown along with representative numerical evaluations. The high accuracy of the calculations and the fact that the angular dependence is always obtainable make the invariant imbedding method a reasonable approach to many problems. (auth)

25404 CANONICAL AND INVOLUTORY TRANSFORMATIONS OF THE VARIATIONAL PROBLEMS OF TRANSPORT THEORY. Kaplan, S.; Davis, James A. (Westinghouse Electric Corp., West Mifflin, Pa.). Nucl. Sci. Eng., 28: 166-76(May 1967).

The notions of canonical and involutory transformations from the calculus of variations are applied to neutron transport problems. It is shown that the variational formulations of Vladimirov, Selengut, Pomraning and Clark, and Davis are related through transformations of this type. It is pointed out that the pair of functionals identified through the involutory transformation are reciprocal in the sense that the minimum of one is the maximum of the other. The implications of this fact for the development of approximation methods are discussed. (auth)

25405 BOUNDARY CONDITION ON THE FLUX OF MONOENERGETIC NEUTRONS AT A PLANE BLACK BOUNDARY. Stewart, J. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Sci. Eng., 28: 310(May 1967).

The flux of monoenergetic neutrons in a uniform nonabsorbing isotropically scattering medium is considered, particularly the divergence of the diffusion-theory prediction for the flux distribution across a plane black boundary from the correct value. (D.C.W.)

25406 COMPUTATION OF TIME-DEPENDENT NEUTRON SPECTRA IN D_2O. Calame, G. P. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng., 28: 308-9(May 1967). (RPI-328-58).

Neutron spectra in D_2O were calculated for different times after the injection of a burst of neutrons using time- and energy-dependent diffusion theory for each spatial mode and explicitly including the higher spatial harmonics. The results were compared with experimental data; excellent agreement was noted. (D.C.W.)

25407 SOME MEASUREMENTS OF DECAY CONSTANTS CLOSE TO $(\nu\Sigma_{inel})_{min}$ IN PULSED BeO ASSEMBLIES. Ritchie, A. I. M.; Rainbow, M. T. (Atomic Energy Commission Research Establishment, Lucas Heights, Australia). Nucl. Sci. Eng., 28: 306-8(May 1967).

Decay constants of the order of the minimum value were measured in BeO assemblies with bucklings of 1.5 to 3.06 × 10^{-2} cm^{-2}. The decay constants were also obtained as a function of time after the end of the pulse. (D.C.W.)

25408 SOLUTION OF THE NEUTRON SLOWING DOWN PROBLEM VIA A MULTIPLE COLLISION APPROACH. Syros, Constantin (CCR-EURATOM, Ispra, Italy). Nucl. Sci. Eng., 28: 203-14(May 1967).

An analytical approach to the solution of the neutron slowing-down problem with anisotropic scattering is presented. The basic ideas are the representation of the transport equation by a set of infinitely many first-order linear partial differential equations, the application of the "central limit theorem," and integral transform techniques. The distribution of the n-times scattered neutrons is given as a superposition of space- and angle-dependent functions with coefficients depending on the energy. In the isotropic case, these coefficients are directly related to the Placzek slowing-down distributions. (auth)

25409 NEUTRON THERMALIZATION IN LIGHT WATER. Young, J. C.; Trimble, G. D.; Neill, J. M.; Houghton, G. K.; Houston, D. H.; Beyster, J. R. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Sci. Eng., 28: 259-69 (May 1967).

Quasi-infinite medium neutron spectra were measured as a function of moderator temperature and poison concentrations in water. Three different poisons were used: a 1/v absorber (boron), and the resonance absorbers erbium and gadolinium. These measurements were performed utilizing the General Atomic Linac and standard time-of-flight techniques. The temperature range covered was from ambient to about 300°C. The measurements were compared to the latest theoretical models using the best known calculational techniques available. The scattering kernel based on the modified Haywood frequency spectra and computed by the GASKET-FLANGE computer codes appears to give the best agreement with the experimental data. (auth)

25410 ANALYSIS OF NEUTRON THERMALIZATION IN BERYLLIUM. Lee, R. R.; Daitch, P. B. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. Nucl. Sci. Eng., 28: 247-58(May 1967). (RPI-328-55).

An eigenvalue-eigenfunction analysis of beryllium assemblies over a large buckling range was performed in a discrete energy representation. Transverse harmonics and the treatment of the energy dependence of the transverse buckling are shown not to change the conclusions. The decay in small assemblies that do not have an asymptotic (discrete) eigenvalue is seen to be dominated by a highly excited region of the continuous eigenvalue spectrum. This is characterized as a pseudo-fundamental eigenvalue-eigenfunction and is seen to be responsible for the observation of experimental decay constants that are greater than the minimum interaction rate. The pseudo-fundamental eigenfunction is peaked at the Bragg energies and describes a trapping of neutrons at these energies for the intermediate times accessible to experiment. It is doubtful that the theoretical long-time buildup of near-zero-energy neutrons, seen as a peak at the lowest energy mesh point for the lowest "continuum" eigenfunction can be observed by experiment. Spatial effects are examined by comparing Marshak and zero-flux boundary-condition results. The Marshak boundary condition gives, for example, a 3% increase in the decay constant and a higher peak in the spectrum at the major Bragg energy for $B^2 = 0.0753$ cm^{-2}. A surface spectrum predicted by diffusion theory is seen to be in qualitative agreement with experiment. The P_3 pseudo-fundamental eigenvalue is nearly identical to the diffusion theory result, lending support to the assumption that transport effects are not dominant for the times, energies, and assembly sizes considered here. Spectra at energies below the Bragg cutoff are very sensitive to the transport approximation used, but these energies are outside the experimental range and have a negligible effect on integral parameters, such as the decay constant. The major features of the theory are checked against experiment. (auth)

25411 INTERACTION OF NEUTRONS WITH MOLECULES. Ivanov, G. K.; Sayasov, Yu. S. (Inst. of Chemical Physics, Moscow). Usp. Fiz. Nauk, 90: 47-84(Sept. 1966). (In Russian).

This review article is devoted essentially to a systematic development of the theory of scattering of fast neutrons by molecules, with special application to the determination of the properties and structure of molecules by means of the fast-neutron spectra. The exposition is limited to the study of spectra of neutron scattering by molecules, and does not include phenomena of chemical transformations under the influence of neutrons. The survey also presents the theory of scattering of slow neutrons by molecules. Since the scattering amplitudes of fast neutrons depend strongly on the energy and exhibit resonances, the theory is presented for the general case of variable amplitudes for neutron-nucleus scattering, using the formalism of the impulse approximation, which is itself described in some detail. A classification of the processes of scattering of neutrons by chemically bound nuclei, as a function of the character of the neutron-nucleus interaction and of the neutron energy, is presented. (76 references) (ATD)

25412 STANDARD FISSION NEUTRON SOURCE. Kooi, J.; Mijnheer, B. J.; Aten, A. H. W. Jr. (IKO, Amsterdam). Radiochim. Acta, 6: 218(Dec. 1966).

A cylindrical fission neutron source that contains approximately 1 μg of ^{252}Cf is described. The results of measurements of the angular dependence of neutron emission and of the absolute number of neutrons emitted are included. (D.C.W.)

25413 INTENSITY CHANGES BY COHERENT EXTINCTION IN THE SCATTERING OF NEUTRONS ON SINGLE CRYSTALS. Kuich, G.; Rauch, H. (Oesterreichische Hochschule, Vienna). Nukleonik, 9: 139-42(Feb. 1967). (In German).

The intensity variations caused by coherent extinction effects in the case of neutron reflection at single crystals are calculated. The mathematical expression for secondary extinction is extended to coherent extinction, and the set of differential equations is solved. A numerical evaluation of the formula is carried out for a single crystal of lead and is compared with the experimental results. (auth)

25414 ENERGY RESOLUTION CONSIDERATIONS IN TIME OF FLIGHT SPECTRAL MEASUREMENTS. Garelis, Edward; Ozeroff, W. J. (General Electric Co., Pleasanton, Calif.). Nukleonik, 9: 142-5(Feb. 1967).

A detailed study of the energy resolution problem for time of flight spectral measurements is given. It is assumed that the source to the flight tube can be characterized by an exponential decay, $\exp(-\alpha t)$. (auth)

25415 IMPROVED VARIATIONAL SOLUTION TO THE ENERGY-DEPENDENT MILNE PROBLEM FOR REALISTIC SCATTERING KERNELS. Kallfelz, J. M.; Reichardt, W. (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 9: 148-55(Feb. 1967).

The variational method of Kladnik and Kuščer is used to obtain an improved solution to the energy-dependent Milne problem. The accuracy of the solution is discussed, and results for various scattering kernels, including both realistic and simple types, are given. The strength of the angular dependence of the Milne problem leakage spectra is directly dependent on the thermalization power of the scattering kernel. (auth)

25416 A CODE OF NEUTRON INTERACTION BETWEEN MULTIPLYING MEDIA FOR IBM-7094. Eletti, G. F.; Simonetta, R. Riv. Ing. Nucl., 4: 919-26(Jan.-Feb. 1966). (In Italian).

The GIARA Code was written to permit a rapid and automatic application of the Clark method for the study of the neutron interaction of various components in the form of units containing fissile materials. The applicability of the code is considered and a description is given of the input data. An example is given of the use of the code. (J.S.R.)

25417 TIME DEPENDENT NEUTRON TRANSPORT IN PLANE GEOMETRY. Mika, Janusz (Inst. of Nuclear Research, Polish Academy of Sciences, Swierk). Nukleonik, 9: 200-5(Mar. 1967).

The structure of the spectrum of the transport operator with the isotropic scattering kernel in plane geometry is derived. The scattering kernel is assumed to be square integrable after symmetrization. The existence of the unique solution to the initial-value problem is proved. The results for plane geometry are checked against those for the bounded geometries. (auth)

25418 MEASUREMENT OF LEAKAGE KERNELS AND SLOWING DOWN PARAMETERS USING THE PULSED SOURCE TECHNIQUE. Wolberg, J. R.; Gozani, Tsahi (Israel Inst. of Tech., Haifa. Atomic Energy Commission, Tel-Aviv, Israel). Nukleonik, 9: 180-7(Mar. 1967).

The relation between leakage kernels and the amplitudes of spatial harmonics of the thermal neutron distribution is developed. The relative leakage of the q^{th} harmonic to the fundamental mode is shown to be proportional to the relative amplitude of the q^{th} harmonic to the fundamental mode. It is suggested that this relation form the basis of a new method for measuring leakage kernels and slowing-down parameters. As an example, the measured amplitude ratios of LOPEZ and BEYSTER are analyzed to yield two fast group slowing-down parameters for the neutron source used in their experiments. The accuracy of the proposed method is investigated as a function of the experimental parameters including the number of spatial points used to determine the spatial distributions, the number of harmonic ratios used in the analysis, the number of time channels used in the analysis, the time after the pulse corresponding to the first time channel, the time from the start of one channel to the next, the amplitude of the fundamental mode, the nuclear parameters of the system, and the dimensions of the system. (auth)

25419 PULSED NEUTRON MEASUREMENTS IN TWO ADJACENT FINITE MEDIA. Giraudbit, Georges P.; Shapiro, Jerome L. (California Inst. of Tech., Pasadena). Nukleonik, 9: 206-8(Mar. 1967).

The diffusion model was tested for the pulsed neutron problem in a nonmultiplying finite heterogeneous system, using a fast neutron source to pulse a two-region assembly. One region of the assembly contained pure distilled water, while the other region contained an aqueous boric acid solution. The decay of the neutron flux with respect to different poison concentrations was studied, and the experimental results were compared with the predictions of the diffusion model. The results indicate that the diffusion model is valid for the case considered. (D.C.W.)

25420 NEUTRON GENERATOR. Suganomata, Shinji; Suematsu, Shigeru (to Hatachi, Ltd.). Japanese Patent 1966-7755. Apr. 19, 1966. Filed Sept. 30, 1964.

A neutron source using an ion-beam target in which gaseous deuterium or tritium is adsorbed on the target base is proposed. (D.C.W.)

25421 NEUTRON GENERATOR. Suematsu, Shigeru; Akatsu, Kaoru (to Hitachi, Ltd.). Japanese Patent 1966-7756. Apr. 19, 1966. Filed Oct. 12, 1964.

A neutron source is proposed in which, by the combined action of potential switches, the accelerated ion beam impinges upon the target only when a neutron target is in the irradiation chamber. (D.C.W.)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 25313, 25318, and 25393.

25422 (JINR-P01-3215) POLYARIZATSIONNYE EFFEKTY PRI NEUPRUGOM Nd-RASSEYANII. 3. KVAZIUPRUGOE pp-RASSEYANIE. (Polarization Effects by Inelastic Nd-Scattering. 3. Quasi-Elastic pp-Scattering). Golovin, B. M.; Kulyukina, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1967. 6p. (In Russian). Dep. mn.

On the basis of the nonrelativistic impulse approximation, polarization parameters are calculated for the "normal total experiment" on quasi-pp scattering in N-d collisions. (auth)

25423 (JINR-P4-3222) PRAVILO SUMM KABIBBO–RADIKATI I FOTORASSHCHEPLENIE TREKHNUKLONNYKH YADER. (Cabibbo–Radicati Sum Rule and Photodisintegration of Three-Nucleon Nuclei). Gerasimov, S. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 5p. (In Russian). Dep.

It follows from the validity of the Cabibbo–Radicati sum rule for the interaction of photons with ^{3}He and ^{3}H nuclei that the reaction of three-particle photodisintegration goes mainly through the $I = 3/2$ state. Some consequences of this result are discussed. (auth)

25424 (ORO-1316-22) NUCLEAR REACTION STUDIES USING POLARIZED ^{3}He TARGETS AND BEAMS. Phillips, G. C. (Rice Univ., Houston, Tex. Bonner Nuclear Labs.). Dec. 2, 1966. Contract AT(40-1)-1316. 18p. (CONF-661205-4). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From Conference on Polarized Targets and Sources, Saclay, France.

The experimental requirements of polarized ^{3}He targets are discussed, together with a system for producing polarized $^3He^+$ beams using optical pumping of vf discharges. Some studies involving polarized ^{3}He targets are reviewed, and some asymmetry measurements for proton elastic scattering by polarized ^{3}He are summarized. (D.C.W.)

25425 THE D(d,p)T REACTION WITH POLARIZED DEUTERONS AT 100 TO 500 KeV. Ad'yasevich, B. P.; Polunin, Yu. P.; Fomenko, D. E. Yadern. Fiz., 5: 713-17(Apr. 1967). (In Russian).

The left-right asymmetry of the emitted protons from the D(d,p)T reaction is measured. The gas deuterium target was bombarded with polarized deuterons. The IAE source of polarized protons and deuterons was used. The asymmetry is measured in the energy range 100–500 KeV at angles from 30 to 150°. From the measurements the energy dependences are obtained of the coefficients B_3 and B_4, introduced by Goldfarb for the description of the studied reaction. The contribution is estimated from the triplet-singlet transitions forbidden in the Born approximation with the tensor and spin-orbit forces taken into account. The strength of analyzation ability of the reaction with polarized deuterons is found. (auth)

25426 DEPOLARIZATION OF SLOW POLARIZED NEUTRONS IN HYDROGEN. Khrushchev, B. I.; Shadmanov, R. Sh.; Sharipova, L. S. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz., 5: 710-12(Apr. 1967). (In Russian).

Depolarization of slow polarized neutrons on hydrogen nuclei is measured in the interval of scattering angles from 9 to 87°. The degree of depolarization does not depend on the scattering angle (that is in accordance with the theory and equals 0.62 ± 0.09. (auth)

25427 ANGULAR DISTRIBUTION OF PHOTOPROTONS FROM THE d(γ,n)p REACTION ($E_\gamma = 8.72$ MeV). Tutakin, P. M. Yadern. Fiz., 5: 701-2(Apr. 1967). (In Russian).

Placing photoplates into D_2O one has obtained the quantities $a/b = 0.088 \pm 0.032$; 0.099 ± 0.019; 0.096 ± 0.030; and 0.112 ± 0.016 in the angular distribution for four "selective geometries" of the photoproton traces. (auth)

25428 A FORTRAN PROGRAMME FOR THE CALCULATION OF STATISTIC WEIGHTS FOR HYPERNUCLEAR IDENTIFICATIONS. Gajewski, W. Bull. Inst. Phys. Univ. Libre Brux., No. 33, 1-30(Mar. 1967).

A statistical method of treating the nonuniquely identified events in the analysis of hypernuclear decays is proposed and the corresponding computer program is presented. The program is prepared in FORTRAN IV for an IBM 7040 computer with about 16,000 core storage locations. (B.G.D.)

25429 THERMAL-NEUTRON CAPTURE CROSS SECTION OF DEUTERIUM. Merritt, Janet S.; Taylor, J. G. V.; Boyd, A. W. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucl. Sci. Eng., 28: 286-92(May 1967).

The 2200 m/sec neutron cross section for deuterium was deter-

mined relative to that for ^{59}Co by absolute counting of the ^{3}H and ^{60}Co produced by neutron irradiation. The result, expressed in terms of the 2200 m/sec cross section for ^{59}Co in b, and of the tritium half life in years, is $1.104 \pm 0.014 \times 10^{-3}$ $[\sigma_0(^{59}Co)]$ $[t_{\frac{1}{2}}(^{3}H)]$ mb. Assuming $\sigma_0(^{59}Co) = 37.4 \times 0.3$ b and $t_{\frac{1}{2}}(^{3}H) = 12.262 \pm 0.004$ years, gives σ_0 (D) = 0.506 ± 0.010 mb. The standard deviation of the mean value from 8 irradiations was ±0.2%. (auth)

25430 REMARKS CONCERNING INELASTIC ELECTRON SCATTERING FROM ^{3}He. Gibson, B. F.; West, G. B. (Stanford Univ., Calif.). Contract AF 49(638)-1389. Nucl. Phys., B1: 349-59(1967).

Previous calculations of the two-body coincidence break-up of ^{3}He have been reexamined in some detail with the object of reconciling an apparent inconsistency between the coincidence and integrated cross-section data. An impulse approximation in which only on-the-mass-shell intermediate nucleon states are kept is employed. Spectator nucleon effects are found to be small. The strong dependence of the cross section on the choice of three-body wave functions previously used in analyses of elastic electron scattering is investigated. The pole approximation gives a best fit to the shapes of the coincidence and integrated cross sections. However, in order that the normalizations agree, a reinterpretation of the coincidence data is proposed. (auth)

25431 LOW-ENERGY INTERACTION OF NUCLEONS WITH ^{3}H AND ^{3}He NUCLEI. Zaikin, D. A.; Sergeev, V. A. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 148-55(Jan. 1966). (In Russian).

One can give a simultaneous treatment of scattering and reactions in terms of an effective potential by employing the concept of isotopic invariance and treating the (n,p) and (p,n) reactions as scattering with isospin flips of the incident α particle and target nucleus. From the point of view of the present model, violation of isotopic invariance is due to the neutron–proton and ^{3}H–^{3}He mass differences, to the Coulomb interaction, and to the small difference between the effective potentials for nucleons in the fields of ^{3}He and ^{3}H. The first two factors are considered. (J.F.P.)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 25244, 25393, 25428, 25485, 25491, 25494, 25518, 25570, and 25581.

25432 (KAPL-P-3329) COUPLED-CHANNEL CALCULATION OF ^{12}C AND ^{16}O NEUTRON CROSS SECTIONS. Reynolds, J. T.; Francis, N. C. (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 6p. (CONF-670414-1). Dep. CFSTI.

From Meeting of the American Physical Society, Washington, D. C.

Coupled-channel calculations were made of cross sections for neutron scattering from ^{12}C and ^{16}O at energies below threshold for inelastic scattering. The coupling between the ground state and the first excited 2+ state was calculated using a collective vibrator model. For both nuclei the coupling produced resonances in the total cross section which were due to an intermediate state formed when the neutron excites the collective 2+ state and drops into a bound single-particle state. (S.F.L.)

25433 (NASA-TN-D-3813) INTERPRETATION OF (d,α) REACTIONS ON ^{19}F AND ^{15}N. Priest, Joseph R.; Vincent, John S. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1967. 22p. CFSTI.

The angular distributions of five alpha-particle groups from ^{19}F(d,α)^{17}O and ^{15}N(d,α)^{13}C were measured. These reactions are alpha-particle emitting reactions from deuterons incident upon ^{19}F and ^{15}N leaving ^{17}O and ^{13}C, respectively, as the residual nuclei. The ground and first two excited states of ^{17}O and the ground and first excited state of ^{13}C were resolved. The nominal deuteron energy was 20.9 MeV in the laboratory system. The distorted-wave Born approximation calculation for a direct-interaction mechanism provided an adequate interpretation of the reactions. The differential cross sections integrated from 20 to 170° were not proportional to 2I + 1 (I is the angular momentum quantum number of the residual state). This was interpreted to be a consequence of a direct-interaction mechanism rather than of a compound-nucleus mechanism. (auth)

25434 ISOBARIC SPIN EFFECTS IN ^{10}B + p. Singh, P. P. (Indiana Univ., Bloomington. Argonne National Lab., Ill.); Segel, R. E.; Hanna, S. S.; Grace, M. A. pp 357-65 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A study was made of the γ-ray emitting states that are formed by bombarding ^{10}B with protons of energy 4 to 12 MeV. The states involved are the five states of ^{10}B excited through (p,p') reactions, two of ^{10}C formed from the (p,n) reaction, and the first excited state of ^{7}Be formed through the (p,α) reaction. The variety of available final states makes it possible to investigate the degree to which various factors (isobaric spin, energy, configuration) influence the decay of states at energies corresponding to states in ^{11}C at excitations from 12 to 19.5 MeV. (S.F.L.)

25435 LOWEST T = $\frac{3}{2}$ STATE IN ^{13}N AS A COMPOUND NUCLEAR RESONANCE. Bredin, D. J.; Hansen, O.; Temmer, G. M.; Van Bree, R. (Rutgers, The State Univ., New Brunswick, N. J.). pp 472-86 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The lowest T = $\frac{3}{2}$ state in ^{13}N was investigated by observing compound resonances in proton scattering by ^{12}C. A single sharp anomaly was found in the 165° excitation function for elastic and inelastic scattering (to the 4.43 MeV, 2^+ and 9.64, 3^- states). The curve was obtained in 5- and 10-keV steps over the crucial region, and gives a typical dispersion shape, superimposed on a very broad structure. The nominal energy for the resonance is 14.212 ± 0.018 MeV, corresponding to an excitation in ^{13}N of 15.047 ± 0.018 MeV. (S.F.L.)

25436 EVIDENCE FOR A DEPENDENCE OF SINGLE-PROTON TRANSFER REACTIONS ON ISOBARIC SPIN. Siemssen, R. H. (Argonne National Lab., Ill.); Morrison, G. C.; Zeidman, B.; Fuchs, H. pp 523-9 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The relative spectroscopic factors from (^{3}He,d) reactions were compared with those from (d,n) reactions for the low T = 0 and T = 1 states in the odd-odd nuclei ^{10}B, ^{14}N, and ^{26}Al. It is widely expected that the (d,n) and the (^{3}He,d) reaction are analogous processes involving proton transfer and that they should therefore yield the same spectroscopic factors. In contrast to this expectation, it was found that the relative spectroscopic factor for the T = 1 state deduced from the (d,n) reaction is less than the spectroscopic factor from the (^{3}He,d) reaction, the spectroscopic factors for the T = 0 states being normalized to each other for the two reactions. (S.F.L.)

25437 STUDY OF THE ISOBARIC-SPIN FORBIDDEN REACTION ^{14}N(α,α_1)^{14*}N (2.31 MeV). Chesterfield, Coral M.; Spicer, B. M. (Univ. of Melbourne). pp 734-8 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The observation of isobaric spin forbidden transitions in a number of (d,α) reactions in light nuclei has led to the search for a similar violation in the inelastic scattering of α-scattering by ^{14}N. The reaction ^{14}N(α,α_1)^{14*}N at α-particle energies between 10 and 13 MeV was chosen for study because of its similarity to the ^{16}O(d,α_1) reaction, which is known to exhibit an isobaric spin forbidden transition. These two reactions have identical channel spins, and the former cannot proceed via a direct interaction mechanism. These reactions can populate only a limited selection of compound states, those of spin and parity 1^-, 2^+, 3^-, 4^+, etc. Thus identical levels of ^{18}F should be excited in the two reactions, and measurements of angular distributions of the α_1 group at isolated levels should indicate their spins and parities. The total cross section for the isobaric spin forbidden transition will, in principle, give an indication of the isobaric spin impurity in the intermediate ^{18}F states. Excitation functions for the α-scattering reaction were measured in 50 keV steps at center-of-mass angles of 67°, 80°, and 90°. The forbidden group was observed clearly in a large number of the spectra. (S.F.L.)

25438 FURTHER SPECULATIONS CONCERNING THE STRUCTURE OF ^{8}Be. Stephenson, G. J. Jr.; Marion, J. B. (California Inst. of Tech., Pasadena). pp 766-73 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A large amount of experimental information has been collected bearing upon the structure and the isobaric spin mixing of the 2^+ and 1^+ doublets in ^{8}Be at 16.63 and 16.93 and 17.64 and 18.15 MeV, respectively. A review is given of the various reactions and methods which have been used to study these states. (S.F.L.)

25439 T = 1 ANALOGUE STATES IN ^{16}O. Barnett, A. R. (Oxford Univ.). pp 774-80 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Energy levels in ^{16}O were studied by the ^{15}N(p,n)^{15}O reaction over the proton energy range 3.8 to 12 MeV. The excitation function of the total cross section was measured by bombarding a transmission gas target with the proton beam from the Harwell tandem generator and detecting the residual B^+ activity from ^{15}O.

The positrons have maximum energy of 1.7 MeV and travel through a thin window in the target chamber walls to a nearby plastic scintillator. Decay curves of ^{15}O β^+ activity are given at bombarding energies of 6.30 and 10.15 MeV, and comparisons of excited states in ^{16}N and ^{16}O are made. (S.F.L.)

25440 T-SPIN VIOLATIONS IN $^{16}O(d,\alpha_1)^{14*}N$. Messelt, S. (Univ. of Wisconsin, Madison). pp 814-22 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Differential cross sections for the $^{16}O(d,\alpha_1)^{14}N^*$ reaction to the first T-spin forbidden T = 1 state of ^{14}N were measured in the energy range E_d = 3 to 5 MeV, and excitation curves for this α_1 group were taken for $\Theta_{c.m.}$ = 30° and $\Theta_{c.m.}$ = 143°, while data on the α-groups to the ground state and second excited state were obtained at several other angles. Resonance structure observed in the excitation functions is discussed. (S.F.L.)

25441 ANALYSIS OF ELASTICALLY SCATTERED DEUTERONS BY MEANS OF STRIPPING REACTIONS. Gofman, Yu. V.; Zaika, N. I.; Mokhnach, A. V.; Nemets, O. F.; Shmarin, P. L.; Yasnogorodskii, A. M. Yadern. Fiz., 5: 718-26(Apr. 1967). (In Russian).

Proton angular distributions in the $^{10}B(d,p)^{11}B_{ground}$ and $^{14}N(d,p)^{15}N_{ground}$ reactions at the incident deuteron energy 13.6 MeV are measured. The proton polarizations are determined in the region of the main maxima in the angular distributions. The asymmetry of protons from the stripping reactions on ^9Be, ^{10}B, ^{12}C, ^{14}N and ^{40}Ca is studied at the interactions of deuterons elastically scattered off carbon and nickel with mentioned nuclei. The asymmetry at the angles θ_l = 12–65° in the first scattering is small in case of nickel and is considerable in case of carbon. The vector polarization of deuterons scattered off carbon is calculated after Sitenko. (auth)

25442 DETECTION OF $^{12}C(p,p)^{12}C$ POLARIZATION. Hsu, Chu-chung; Yang, Ying-chuan; Lee, Tsong-jen (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan), 4: 49-54 (Oct. 1966).

The angular distribution of polarization in p-^{12}C elastic scattering was measured for laboratory scattering angles of 50, 70, 90, and 120° at E_p = 2.875 MeV, and the polarization as a function of energy at θ_l = 50° was determined. A phase analysis of the data was carried out at the energy where angular distribution was measured. It is shown that the phase variation of 1.6° of δ_1^+ and 3.5° of δ_2^+ from the phase obtained by C. W. Rerich, et al. (Phys. Rev. 104: 143(1956)) do not influence the angular distribution of the cross section within the limit of experimental errors. (auth)

25443 SPALLATION OF LIGHT NUCLEI. Audouze, Jean (Institut d'Astrophysique, Paris); Epherre, Marcelle; Reeves, Hubert. Nucl. Phys., A97: 144-63(1967).

The experimental data on proton and neutron spallation of light nuclei ($9 \leq A \leq 32$) were gathered and analyzed. The important features are made quantitative in terms of certain parameters, similar, (but not identical) to those used by Rudstam to study heavier nuclei ($A > 40$). These parameters will be useful for predictions of unmeasured cross-sections. In the range from about 90 MeV to several GeV the cross sections for reactions leading to more than three outgoing particles on light nuclei are, in the average, very smooth functions of a small set of physical parameters, which can be qualitatively related to the nuclear processes involved. The governing factors are the third component of the isospin ($T_3 = \frac{1}{2}(N-Z)$) and the mass A of the target nucleus (A_t, T_{3t}) and of the observed product nucleus (A_p, T_{3p}) and the incident nucleon energy E_p. The influence of each one of these five parameters on the cross sections is discussed with the help of the Serber two-step model. (auth)

25444 DEUTERON TENSOR POLARIZATION IN THE $^9Be(p,d)^8Be$ REACTION. Ivanovich, M.; Cords, H.; Din, G. U. (Australian National Univ., Canberra). Nucl. Phys., A97: 177-86(1967).

The spin tensor moments $\langle T_{20}\rangle$, $\langle T_{21}\rangle$ and $\langle T_{22}\rangle$ of deuterons from the $^9Be(p,d)^8Be$ reaction were measured at four proton bombarding energies of 4.91, 6.90, 8.27, and 9.80 MeV. The measurements were carried out for each energy at laboratory emission angles of 22.5°, 30°, 45° and 60°. In addition, θ_{lab} = 0° measurements were made at the two lower energies. (auth)

25445 GAMMA DECAY OF THE 5.25- AND 5.37-MeV LEVELS OF ^{18}O. Moreh, Raymond (Univ. of Manchester, Eng. Atomic Energy Commission, Negev, Israel). Nucl. Phys., A97: 106-12(1967).

Proton-gamma coincidence measurements in the reaction $^{17}O(d,p\gamma)^{18}O$ indicate that the 5.25-MeV level of ^{18}O decays 59 ± 6% to the 1.98-MeV level and 41 ± 6% to the ground state. The 5.37-MeV level decays 88 ± 3% to the 1.98-MeV level and 12 ± 3% to the 3.92-MeV level. Upper limits are given for possible transitions to other levels. The gamma decay is consistent with the spins and parities 2^+ and 3^+ of the 5.25- and 5.37-MeV levels, respectively. (auth)

25446 STUDY OF THE REACTIONS $^6Li(d,\alpha)$, (d,p_0), AND (d,p_1) AND $^{10}B(d,\alpha_0)$, (d,α_1) AT LOW ENERGY EXPERIMENTAL RESULTS). Longequeue, N. (Univ., Grenoble, France. Centre d'Etudes Nucleaires, Grenoble, France): Cavaignac, M. M. J. F.; Ligeon, E.; Longequeue, J. P.; Beaumevieille, H. J. Phys. (Paris), 27: 649-53(Nov.-Dec. 1966). (In French).

In order to test the validity of the direct interaction process in (d,p) reactions at very low energies, the angular distributions and excitation curves of the reactions $^6Li(d,\alpha)$, (d,p_0), (d,p_1), and $^{10}B(d,\alpha_0)$, (d,α_1), (d,p_0), (d,p_1), (d,p_2) were studied from 0.2 to 1 MeV. (auth)

25447 SEQUENTIAL DECAY IN THE REACTION $^{14}N(\alpha,\alpha p)$ $^{13}C(0)$ AT E_α = 22.9 MeV. Becker, T.; Baehr, K.; Jahr, R.; Kuhlman, W. (Max-Planck Institute fuer Kernphysik, Heidelberg). Phys. Lett., 24B: 458-61(May 1, 1967).

From α-p angular correlation experiments using three-dimensional pulse-height analysis it is shown that the reaction $^{14}N(\alpha,\alpha p)$ $^{13}C(0)$ predominantly proceeds by a sequential reaction mechanism via selected compound states of ^{14}N and ^{17}O. (auth)

25448 COMPILATION OF BINDING ENERGY VALUES OF LIGHT HYPERNUCLEI. Gajewski, W. (Univ. Libre, Brussels); Mayeur, C.; Sacton, J. (and others). Nucl. Phys., B1: 105-13 (1967).

The results of a compilation of the binding energy values of light hypernuclei ($A \leq 16$) obtained by the European K^- Collaboration and the EFINS-Northwestern Collaboration are presented. The events were analyzed by the same computer program and uniform stringent selection criteria were applied. (auth)

25449 THE $\pi^\pm NN$ PROCESSES ON LIGHT NUCLEI. Kopaleishvili, T. I. (Tbilisi State Univ., USSR). Nucl. Phys., B1: 335-48(1967).

The reactions π^-NN with π^- mesons at rest and the reactions $\pi^\pm NN$ with moving $\pi^\pm$ mesons on the nuclei ^{16}O and ^{12}C were investigated taking strictly into account the interaction between emitted nucleons. The results are compared with previous results and with experimental data. Some conclusions are drawn about the applicability of the independent-pair model to these nuclei, the pairing correlation of the nucleons in the nucleus and the two-hole excitation of the residual nuclei. Other aspects of the phenomenon are discussed. (auth)

25450 EXCITATION OF THE GIANT DIPOLE RESONANCE IN μ CAPTURE. Balashov, V. V. (Moscow State Univ.); Korenman, G. Ya.; Korotkih, V. L.; Fetisov, V. N. Nucl. Phys., B1: 158-68(1967).

A previously proposed approximate method of the unified reaction theory is applied to the problem of neutron emission in muon capture. The obtained total first-forbidden transition probability for the reaction $^{16}O(\mu^-,\nu n)^{15}N$ is in agreement with the experiment. The resonance structure of the neutron spectrum appears as a consequence of the channel coupling. (auth)

25451 CALCULATION AND MEASUREMENT OF THE QUANTITIES OF HELIUM PRODUCED BY (n,2n) REACTIONS AND (n,α) IN IRRADIATED BERYLLIUM. Droulers, Y. (CEN, Grenoble, France); Pleyber, G.; Carteret, Y; Lucas, R.; Bareau, J. J. Nucl. Mater., 21: 337-42(Mar. 1967). (In French).

The quantity of helium formed in beryllium samples irradiated in a flux of fast neutrons was calculated and measured. Agreement was satisfactory. Helium analysis in irradiated beryllium permits calculation of a mean effective cross-section for a given neutron spectrum if the neutron dose is known, and establishment of the neutron dose if the mean effective cross-section in the relevant neutron spectrum is known. (auth)

25452 REACTION $^{15}N(p,\alpha)^{12}C$ IN THE ENERGY RANGE OF PROTONS FROM 6.70 TO 15.16 MeV. Nonaka, Itaru (Tokyo Univ.); Mikumo, Takashi; Koike, Masahiro; Matsuda, Kazuhisa; Suzuki, Arata; Nagahara, Yukio; Kikuchi, Ken; Maki, Takashi. J. Phys. Soc. Jap., 22: 949-59(Apr. 1967).

Studies on excitation functions and angular distributions of alpha particles emitted in the reaction $^{15}N(p,\alpha)^{12}C$ were performed in the energy range of protons from 6.70 to 15.16 MeV. Excitation functions at 60, 90, 120, and 150° were measured in steps of 100 keV. Angular distributions of alpha-particles associated with the ground and the first excited states of ^{12}C were also measured in steps of 400 keV (200 keV when necessary). Many sharp or broad peaks were found in the excitation curves. The shapes of the angular distributions depend sensitively on the incident proton energy. Analysis of the results according to the cross-section fluctuation theory by Fricson shows that the proportion of direct reaction is large for this reaction. (auth)

25453 A RESONANCE IN THE $^{16}O + {}^{3}He$ REACTIONS AT 5.05-MeV BOMBARDING ENERGY. Roepke, H.; Lieb, K. P.; Koenig, R. (Univ., Freiburg i. B.). Nucl. Phys., A97: 609-19 (1967).

A search for resonances in the $^{16}O + {}^{3}He$ reactions was performed for bombarding energies between 3.5 and 5.6 MeV. The reaction channels investigated are elastic scattering, (^{3}He,p), and (^{3}He,α_0). Several excitation functions and angular distributions were measured for bombarding energies between 4.5 and 5.5 MeV. Evidence of a resonance near 5.05 MeV was obtained in the elastic scattering channel and in the proton channels p_0, p_1, and p_3. The elastic scattering excitation functions can be fitted by adding a one-level compound state scattering amplitude to a potential scattering amplitude. The spin-parity assignment obtained for the compound state at 13.45 MeV in ^{19}Ne is $J^{\pi} = \frac{1}{2}^{+}$. Approximate values are given for the partial widths. (auth)

25454 A STUDY OF THE $^{16}O(d,p)^{17}O$ REACTION. Alty, J. L.; Green, L. L.; Huby, R.; Jones, G. D.; Mines, J. R.; Sharpey-Schafer, J. F. (Univ. of Liverpool). Nucl. Phys., A97: 541-60(1967).

Angular distributions and excitation functions were obtained for the $^{16}O(d,p)^{17}O$ reaction and the elastic scattering of deuterons on ^{16}O and protons on ^{17}O. An optical-model analysis was made of the elastic scattering results. A vector spin-orbit term was needed in order to fit the back-angle deuteron data. The optical model parameters were used in distorted-wave calculations for the stripping reactions leading to the bound and virtual single-particle states of ^{17}O. The significance of the spectroscopic factors obtained is discussed in detail. (auth)

25455 ORIGIN OF THE FINE STRUCTURE IN THE GIANT RESONANCE OF ^{16}O. Gillet, V.; Melkanoff, M. A.; Raynal, J. (CEN, Gif-sur-Yvette, France. Univ. of California, Los Angeles). Nucl. Phys., A97: 631-40(1967).

The fine structure of nuclear continuum states is interpreted in the framework of the shell model as the result of coupling simple unbound configurations to more complicated many-particle–many-hole cluster-like quasi-bound states. Thus the splitting of the 22-MeV peak of the giant resonance is ascertained both theoretically and experimentally [(d,γ) experiment of M. Suffert] to be due to the existence of a two-particle-two-hole coherent quasi-bound state lying in the dip of the photoabsorption cross section. On the other hand, the 2p-2h mechanism can not account for the 21.7-MeV structure, nor by itself for the structure above 24 MeV. Analysis of cluster transfer experiments [(^{4}He,γ) of M. Suffert and M. Feldman, and (^{3}He,γ) of N. Puttasswamy and D. Kohler] indicate the existence of a 4p-4h quasi-bound state in the vicinity of the 21.7-MeV structure, and of 3p-3h quasi-bound states above 24-MeV. (auth)

25456 ELECTRON SCATTERING FROM ^{9}Be. Bernheim, M.; Stovall, T.; Vinciguerra, D. (Ecole Normale Superieure, Orsay, France). Nucl. Phys., A97: 488-504(1967).

The cross sections for high-energy electrons scattered from ^{9}Be are measured. The results are compared with theoretical predictions. (auth)

25457 EXCITED STATES OF ^{10}C FROM THE $^{12}C(p,t)^{10}C$ REACTION AT E_p = 43 AND 52 MeV. Benenson, W.; Crawley, G. M.; Dreisbach, J. D.; Johnson, W. P. (Michigan State Univ., East Lansing). Nucl. Phys., A97: 510-14(1967).

The $^{12}C(p,t)^{10}C$ reaction was studied at proton energies of 43 and 52 MeV. Levels in ^{10}C were observed at 3.36, 5.29, and 6.61 MeV. Angular distributions were obtained for the ground, 3.36-MeV, and 5.29-MeV states. These results indicate a spin and parity of 0^{+} and 2^{+} for the ground and 3.36-MeV states, respectively. (auth)

25458 NEW HIGH-SPIN LEVELS IN ^{20}Ne. Kuehner, J. A.; Almqvist, E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 45: 1605-16(May 1967).

Levels of ^{20}Ne at excitation energies of 10.57, 12.19, and 13.39 MeV were formed in the $^{12}C(^{12}C,\alpha)^{20}Ne$ reaction. Angular correlations of deexciting alpha particles were measured, leading to spin and parity assignments of 4^{+}, 6^{+}, and 7^{-}, respectively. Level energy systematics and systematics of reduced alpha-particle widths suggest that these levels are associated with rotational bands. (auth)

25459 EXPERIMENTS ON THE EMISSIONS FROM THE NUCLEAR REACTION $^{11}B(p,3\alpha)$ AT THE 675-keV RESONANCE. Kamke, D.; Krug, J. (Ruhr–Univ., Bochum, Ger. Philipps–Univ., Marburg, Ger.). Z. Phys., 201: 301-22(1967). (In German).

In a continuation of measurements at very low energies, the correlation in angle and energy of two of the emitted α particles was measured with standard coincidence techniques at a proton energy of 675 keV (2^{-} level in ^{12}C at 16.57 MeV) by placing two surface-barrier detectors in the plane perpendicular to the beam. The results are displayed in a Dalitz-diagram; the pertinent formulas for conversion from the laboratory system to the center of mass system are given. The distribution of points in this plot shows that the decay from the level excited in ^{12}C proceeds only by sequential decay. This confirms earlier results found at very low energies (130 keV and 250 keV) but differs from those found at a proton energy of 163 keV (2^{+} level in ^{12}C at 16.11 MeV). (auth)

25460 MEASUREMENT OF THE LIFETIME OF THE FIRST EXCITED STATE IN ^{17}O AND ^{17}F. Bizzeti, P. G.; Bizzeti-Sona, A. M.; Kalbitzer, S.; Povh, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Heidelberg). Z. Phys., 201: 295-300(1967).

A new version of the "recoil-distance method," making use of a gas target, was used to determine the lifetime of the 871-keV level in ^{17}O and of the 495-keV level in ^{17}F. The measured values of the lifetimes are $2.32 \pm 0.08 \times 10^{-10}$ sec and $3.96 \pm 0.10 \times 10^{-10}$ sec for ^{17}O and ^{17}F, respectively. (auth)

25461 APPLICATION OF THE PROJECTION METHOD TO CALCULATING THE ENERGY LEVELS OF LIGHT NUCLEI. Baron, G.; Rouhaninejad, H. (Centre de Recherches Nucleaires, Strasbourg). J. Phys. (Paris), 28: 142-6(Feb. 1967). (In French).

The projection method was used to calculate the energies of the lower states of light nuclei. For even nuclei, the binding energy of the ground state and the energies of the levels of the associated rotational band were calculated treating ^{9}Be and ^{12}C as examples. For odd nuclei, the binding energy of the ground state and the energy of the first excited state were calculated using ^{9}Be and ^{13}C as examples. (D.C.W.)

25462 QUASI-ELASTIC SCATTERING p-α IN ^{12}C. Gauvin, H. (Institut de Physique Nucleaire, Orsay, France); Chastel, R. J. Phys. (Paris), 28: 129-34(Feb. 1967). (In French).

A study was made of 152 $^{12}C(p,p\alpha)^{8}Be$ events induced by 90-MeV protons in nuclear emulsion. Angular correlations between the scattered proton and the most energetic α particle show that quasi-elastic scattering can describe the events. The excitation energy, momentum, and angular distribution of the recoil nucleus ^{8}Be, detected by two α particles were obtained and were interpreted by this mechanism. (auth)

25463 ANALYSIS OF THE SPECTRA OF α PARTICLES IN THE REACTIONS $d + {}^{7}Li = n + 2\alpha$ AND $^{6}Li + t = n + 2\alpha$. Berrada, M. (Faculte des Sciences, Bordeaux); Laugier, J.-P.; Lemeille, C.; Saunier, N.; Marquez, L. J. Phys. (Paris), 28: 135-8(Feb. 1967). (In French).

In order to test an assumption for the formation of nuclear molecules, the reactions $d + {}^{7}Li$ at 0.250 MeV and $^{6}Li + t$ from 0.7 to 1.3 MeV were studied. The shapes of the α-particle spectra were analyzed. It was concluded that it is necessary to have two stable centers for the formation of nuclear molecules. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 24049, 25239, 25244, 25393, 25436, 25441, 25443, 25508, 25518, 25533, 25545, 25567, 25570, and 25580.

25464 (CEA-R-3128) ETUDE DES RESONANCES DE NEUTRONS POUR LES ISOTOPES DU BARYUM ET DU CUIVRE PAR LA METHODE DE TEMPS-DE-VOL A BASSE ENERGIE (0–15 keV). (Study of Neutron Resonances of Barium and Copper Isotopes by the Time-of-Flight Method at Low Energies (0 to 15 keV)). Chevillon-Pitollat, Pierre-Louis (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1967. 122p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay, France.

Resonance parameters for Cu at 0 to 15 keV and for Ba at 0 to 1 keV were determined using the time-of-flight method. The sum coincident method was used for spin assignment ($J = I \pm \frac{1}{2}$) in the Ba studies. A careful analysis of transmission curves including interference effects between levels of the same spin afforded assignment of the J values to most of the Cu resonances. Strength functions obtained for these nuclei confirm previous results for other nuclei having the same spin. Total radiative widths exhibit large fluctuations for different isotopes of Ba and Cu. The experimental methods are described in detail and are discussed in view of theoretical predictions. (auth)

25465 (NIM-41) TABLE OF THE ISOMERIC STATES OF STABLE NUCLIDES. Uken, E.-A.; Steele, T. W. (National Inst. for Metallurgy, Johannesburg (South Africa)). June 15, 1966. 29p. Dep. mn.

Information on the isomeric states of stable nuclei, including the Q-values of the reactions by which the isomers were produced, is presented. The gamma energies and half lives of both the isomeric and normal states are included. (D.C.W.)

25466 (UCRL-14346) PRODUCTION OF TRITIUM AND ^{3}He BY PROTON BOMBARDMENT OF METALS; SOLAR ORIGIN OF TERRESTRIAL TRITIUM. Ide, R. H.; Libby, W. F. (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 8, 1965. Contract W-7405-eng-48. 15p. (CONF-651101-88). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 13th Conference on Remote Systems Technology, Washington, D. C.

Radiochemical analyses of recovered satellites have generated considerable interest in nuclear reactions initiated by relatively low-energy (<150-MeV) solar protons. Of particular interest are the results obtained for the Discoverer XVII satellite, which was in orbit during the intense solar flare of November 12, 1960. The amounts of tritium and helium-3 found in portions of the recovered satellite appear to be one and two orders of magnitude too large, respectively, to be explained as products of reactions induced by solar protons. The fact that the helium-3 content was roughly ten times that of tritium is especially interesting, since proton-induced nuclear reactions were expected to produce roughly equal amounts of these two isotopes. To help explain these results, measurements of the cross sections for the production of tritium and helium-3, and especially of the ratio of these cross sections, for proton energies in the vicinity of 30 to 50 MeV were desired. Accordingly, targets of aluminum and iron were bombarded with 35 to 45 MeV protons. Each target was then split, and the relative gross gamma activity of the two portions was determined. One portion of each target, together with blanks of the target materials, was then exposed to a thermal neutron flux of about 5×10^{13} n/cm^2. The tritium content of all the samples was determined by a system of vacuum extraction and gas counting. The results indicate that the ratio $\sigma He^3/\sigma H^3$ for bombardment of both aluminum and iron with 35 to 45-MeV protons lies in the range 0.8 to 1.4. (auth)

25467 HIGH RESOLUTION STUDIES OF SOME ISOBARIC LEVELS. Bilpuch, E. G. (Duke Univ., Durham, N. C.). pp 235-67 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Charged-particle reactions are described in which a Van de Graaff accelerator was used in conjunction with high-resolution beam-handling and detection equipment. High-resolution data are given on the reactions (p,p), (p,α), (p,n), (p,p') and (p,γ) with ^{40}Ar. (S.F.L.)

25468 EXCITATION OF ISOBARIC ANALOGUE STATES IN MEDIUM-WEIGHT NUCLEI BY THE (^{3}He,α) REACTION. Braid, T. H.; Meyer-Schuetzmeister, L.; Borlin, D. D. (Argonne National Lab., Ill.). pp 605-11 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Since the (^{3}He,α) reaction has large positive Q values for nuclei in the 1f$_{\frac{7}{2}}$ region, it provides a very convenient means of studying the formation of both the $T_0 - \frac{1}{2}$ and $T_0 + \frac{1}{2}$ states which can be excited in the pickup of a neutron from a target of isobaric spin T_0. Spectra were measured to find the energies of these levels in even-z, even-N target isotopes of Cr, Fe, Ni, and Ti and the even-N isotopes ^{45}Sc and ^{51}V. Typical spectra are given for α particles from (^{3}He,α) reactions on ^{54}Fe, ^{56}Fe, and ^{51}V, and the peaks corresponding to analog states resulting from pickup of a 1f$_{\frac{7}{2}}$ neutron are indicated. (S.F.L.)

25469 ISOBARIC ANALOGUE RESONANCES OF THE ^{51}V(p,γ)^{52}Cr AND ^{51}V(p,n)^{51}Cr REACTIONS. Teranishi, E.; Furubayashi, B. (Electrotechnical Lab., Tokyo). pp 640-6 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Analog resonances are reported for ^{52}Cr corresponding to the ground and low-lying excited states in ^{52}V observed in the ^{51}V(p,γ)^{52}Cr and ^{51}V(p,n)^{51}Cr reactions. Excitation curves of the (p,γ) reaction in the energy range E_p = 0.6 to 2.7 MeV and the (p,n) reaction in the E_p = 2.0 to 2.6 MeV region were measured using protons from a 3-MeV Van de Graaff accelerator and a vacuum-evaporated natural vanadium target. (S.F.L.)

25470 T = $\frac{3}{2}$ ANALOGUE LEVELS IN MASS 25 AND 29. Hardy, J. C.; Skyrme, D. J. (Oxford Univ.). pp 701-12 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Analog levels with T = $\frac{3}{2}$ were investigated in mass 25 and 29 nuclei by the reactions ^{27}Al(p,t)^{25}Al, ^{27}Al(p,^{3}He)^{25}Mg, ^{31}P(p,t)^{29}P, and ^{31}P(p,^{3}He)^{29}Si induced by 40.3 MeV protons. Energy spectra, angular distributions, and discussions of the data are given. (S.F.L.)

25471 EXCITATION OF ISOBARIC ANALOGUE STATES BY THE (d,n) REACTION. Lawergren, B.; Morrison, G. C.; Ferguson, A. T. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 739-47 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A report is given on high-resolution studies of the reactions ^{23}Na(d,n)^{24}Mg and ^{27}Al(d,n)^{28}Si which were carried out at a deuteron energy of 3 MeV using a pulsed Van de Graaff and time-of-flight spectroscopy. The purpose of the experiments is to study the excitation of isobaric analog states on the 2s-1d shell nuclei. In order to reach the region of high excitation energies where isobaric analog states are expected in the final nucleus, the bias of the neutron detector was set such that neutrons down to 150 keV energy could be detected. With this setting, a range of excitation energies up to 2 to 3 MeV above the ground state analog could be examined. Angular distributions were measured at 10° intervals in the forward direction and at larger intervals elsewhere. The shapes of the angular distributions were used to determine l values. Isobaric analog states were identified by comparing with the positions, l values, and intensities of levels excited in (d,p) reactions leading to the analog nucleus. (S.F.L.)

25472 STUDY OF ISOBARIC SPIN PURITY OF ANALOGUE STATES IN ^{59}Cu. Morrison, G. C.; Schiffer, J. P. (Argonne National Lab., Ill.). pp 748-56 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A high-resolution study was made of analog states of Cu isotopes excited in the (^{3}He,d) reaction on Ni isotopes using the 18-MeV ^{3}He beam from the Argonne Tandem Van de Graaff accelerator and a broad-range magnetic spectrograph. A composite spectrum for the ^{58}Ni(^{3}He,d)^{59}Cu reaction showing the region of excitation for the analog states is given and results are summarized in a table. The reactions on ^{60}Ni, ^{62}Ni, and ^{64}Ni yielded little new information. Two analog states were observed in ^{61}Cu, but none in ^{62}Cu and ^{65}Cu. (S.F.L.)

25473 SPIN MEASUREMENT OF ^{64}Ga; PRELIMINARY RESULTS. Deutsch, J. P.; Grenacs, L. (Univ. of Louvain, Belg.). pp 881-92 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

An experiment was performed to measure the beta-gamma circular polarization correlation between beta particles emitted by ^{64}Ga and the high-energy gamma rays ($E_\gamma \approx$ 3.3 MeV) of the daughter nucleus. This correlation is sensitive to the spin assignment of the ground state of ^{64}Ga, and was designed to determine this spin. Preliminary results indicate that a 0-spin assignment to the ground-state of ^{64}Ga is strongly favored. (S.F.L.)

25474 ISOMER SHIFT OF ^{57}Fe IN IRON. Ingalls, R. (Univ. of Illinois, Urbana). Phys. Rev., 155: 157-65(Mar. 10, 1967). (COO-1198-388).

The contributions to the ^{57}Fe isomer shift in bcc iron are calculated. Both the direct density at the nucleus due to 4s-like conduction electrons and the modification of the 3s density at the nucleus through 3d shielding are considered. Wave functions for the solid are calculated using Stern's modified tight-binding (MTB) method. These are coupled with a decomposition of the total density of states, obtained by Wood and by Cornwell and Wohlfarth, into separate components associated with s-, p-, and d-like character of the the conduction-band wave functions. Special attention is given the variation of the isomer shift with atomic volume, and the amount of s and d character on the iron atom. One is able to account qualitatively for the measured volume dependence of the isomer shift, as well as the anomalies at the Curie-point, bcc-fcc, and bcc-hcp transitions. However, the constant of proportionality between isomer shift and density at the nucleus can not be determined here with much accuracy. (auth)

25475 TOTAL CROSS SECTIONS OF CALCIUM AND POTASSIUM FOR FAST NEUTRONS. Bacon, E. G. Jr.; Wickstrom, C. J. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Nucl. Sci. Eng., 28: 293-5(May 1967).

Total neutron cross sections for calcium and potassium have been measured using the transmission method. Monoenergetic neutrons were produced by the D(d,n)^{3}He and T(d,n)^{4}He reactions using the USANDL 750-keV Cockcroft-Walton accelerator. Measurements for each element were made at 7 neutron energies between 2.37 and 16 MeV. The measured total neutron cross sections range from 3.53 to 2.06 b for Ca and from 3.23 to 1.98 b for K. (auth)

25476 THE GAMMA-RAY BRANCHING OF ^{85}Kr. Denecke, B.; De Roost, E.; Spernol, A.; Vaninbroukx, R. (EURATOM, Geel, Belg.). Nucl. Sci. Eng., 28: 305-6(May 1967).

The branching ratio for the 514-keV gamma transition in the

decay of ^{85}Kr was measured to be 0.435 ± 0.013% with an accuracy of at least 3%. (D.C.W.)

25477 EMISSION OF DOUBLE CHARGED PARTICLES IN THE DISINTEGRATION OF NUCLEI BY PROTONS AND ANTIPROTONS. Takibaev, Zh. S.; Shalagina, E. V.; Titova, N. S.; Shtern, G. R. (Kazakh State Univ., Alma-Ata, USSR). Yadern. Fiz., 5: 703-9(Apr. 1967). (In Russian).

The emission of ^{4}He nuclei with momentum >800 MeV/c produced in the interaction of 2.26 GeV protons and 2.23 GeV antiprotons with nuclei in the photoemulsion was studied. The distributions of grey and thin tracks in stars with and without He-nuclei were analyzed at different energies of the primary particle. The double charged particle emission in the disintegration of nuclei can't be explained by the absorption of pions by nuclear α-clusters as well as in terms of statistical model of Hagedorn. The obtained results indicate the connection between the internuclear cascade processes and the emission of the fast helium nuclei. (auth)

25478 GAMMA RAYS FROM ^{109m}Pd. Nagahara, T.; Hattori, M.; Kitao, K. (Rikkyo Univ., Japan). Radioisotopes (Tokyo), 16: 8344(Feb. 1967).

The gamma spectrum for ^{109m}Pd was determined using a Be(Li) detector. The measurement was started one minute after the end of neutron irradiation. The value obtained for the dominant gamma rays was 189.1 ± 0.3 keV. The decay of this peak was measured, and a half-life of 4.7 ± 0.1 min was obtained. (D.H.M.)

25479 DETERMINATION OF THE TOTAL MASS ABSORPTION COEFFICIENTS FOR γ AND X RAYS IN THE REGION OF 30 TO 200 keV. Knerr, R. P.; Vonach, H. (Technische Hochschule, Munich). Z. Angew. Phys., 22: 507-10(1967). (In German).

A number of new measurements of total mass absorption coefficients were carried out for γ energies between 30 and 200 keV. A crystal diffraction spectrometer was used as an analyzer of the γ- and x-ray lines. By means of this instrument monoenergetic photon lines at 32.64; 41.53; 42.98; 51.42; 68.17; 79.5; 88.97; 97.11; 180.86; 182.0; and 199.25 keV were isolated from the capture γ-ray spectra of Gd, Eu, and Rh; and the mass absorption coefficients of Ti, Fe, Cu, Zn, Mo, Cd, Sn, Nd, Gd, Ho, Yb, W, and Pb were investigated at these photon energies. The crystal diffraction spectrometer allowed on elimination of most of the systematical errors like the detection of scattered radiation. The total accuracy (determined by the counting statistics) was about 2% at almost all measurements. (auth)

25480 (p,n) MEASUREMENTS OF COULOMB DISPLACEMENT ENERGIES. Cookson, J. A.; Dandy, D. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Nucl. Phys., A97: 232-40(1967).

Reactions (p,n) on eight nuclei in the $f_{\frac{7}{2}}$ region of nuclear mass were studied by the time-of-flight technique. In each case the analog of the target ground state was seen, and the Coulomb displacement energy was obtained with an uncertainty of usually about 20 keV. The results disagreed with previous (p,n) measurements but agreed better with values obtained by other techniques. After allowance for experimental resolution, the analog-state groups were estimated to be not wider than 50 keV. (auth)

25481 THE REACTIONS ^{60}Ni(p,n)^{60}Cu AND ^{60}Ni(α,n)^{63}Zn. Birstein, L.; Drory, Ch.; Jaffe, A. A.; Zioni, Y. (Hebrew Univ., Jerusalem). Nucl. Phys., A97: 203-8(1967).

The reaction ^{60}Ni(p,n)^{60}Cu was studied by several experimental techniques and levels in ^{60}Cu were observed at excitations of 62, 287, 332, 364, and 455 keV. The reaction ^{60}Ni(α,n)^{63}Zn was also investigated, and the results confirm the existence of states in ^{63}Zn at 190, 246, 627, 636, and 1061 keV. (auth)

25482 GAMMA RAYS FROM THE ^{31}P(n,γ)^{32}P REACTION. van Middelkoop, G. (Rijksuniversiteit, Utrecht). Nucl. Phys., A97: 209-16(1967).

The ^{31}P(n,γ)^{32}P reaction was studied with a 5 cm^3 Ge(Li) counter. Altogether, 54 γ-rays were detected with experimental energy errors between 0.4 and 3.0 keV. The Q-value of the reaction is determined as Q = 7936.8 ± 0.8 keV. (auth)

25483 THE ^{25}Mg(^{3}He,α) REACTION AT E(^{3}He) = 33.0 MeV. Dehnhard, D.; Mayer-Boericke, C. (Argonne National Lab., Ill.). Nucl. Phys., A97: 164-76(1967).

Angular distributions of the (^{3}He,α) neutron pickup reaction on ^{25}Mg($J^\pi = \frac{5}{2}^+$) leaving the final nucleus ^{24}Mg in its ground-state rotational band (K = 0; $J^\pi = 0^+, 2^+, 4^+$) were measured at an incident energy E(^{3}He) = 33.0 MeV. The striking similarity between the shapes of the three observed angular distributions suggests a pure l = 2, j = $\frac{5}{2}$ transition to the two excited states, and for the ground state. Relative spectroscopic factors were extracted by DWBA calculations. The results were compared with previous experiments in which the neutron pickup from ^{25}Mg was investigated by means of the (p,d) and (d,t) reaction and with values calculated from the rotational model. The elastic scattering angular distribution ^{25}Mg(^{3}He,^{3}He) at 33 MeV was measured and analyzed in terms of an optical model. (auth)

25484 SHELL-MODEL CALCULATIONS ON ^{52}V. Gersch, H. U.; Riedel, C.; Rudolph, W. (Central Inst. for Nuclear Research, Rossendorf, Ger.). Nucl. Phys., A97: 65-77(1967).

Based on the assumption that the low-lying states of ^{52}V can be described by three protons in the $f_{\frac{7}{2}}$ shell and one neutron in the $p_{\frac{3}{2}}$, $p_{\frac{1}{2}}$, and $f_{\frac{5}{2}}$ shells, the excitation energies and the corresponding eigenfunctions were calculated. The proton-neutron interaction was chosen as the potential of an exchange force with a Gaussian radial shape. The range and the strength as well as the exchange character were treated as free parameters. The matrix elements of the proton-proton interaction were determined using the level scheme of the neighbouring nucleus ^{51}V. The single-particle energies are also taken from experimental data. The results of the shell-model calculation are in fairly good agreement with the experimental data not only for the excitation energies but also for the spectroscopic factors of the ^{51}V(d,p)^{52}V reaction, the branching ratios for M1 transitions and the lifetime of a recently found 5^+ isomeric state. (auth)

25485 DETERMINATION OF SPINS OF LEVELS OF ^{20}F BETWEEN 7,025 AND 7,700 MeV AND OF ^{28}Al BETWEEN 8,300 AND 8,890 MeV. Cabe, Jean; Laurat, Michel; Yvon, Pierre (Commissariat a l'Energie Atomique, Paris). J. Phys. (Paris), 27: 755-9(Nov.-Dec. 1966). (In French).

The precise energy levels of the compound nuclei of ^{20}F* and ^{28}Al* were obtained by total cross section measurements of ^{19}F and ^{27}Al bombarded by over the energy range 450 to 1,200 keV. The cross-section values versus energy for neutrons on ^{19}F show seven separated peaks. These peaks either confirm or give precise measurements of known energy levels. Four of them can be considered as well resolved resonances of the compound nucleus. The total angular momentum corresponding to these levels was calculated taking into account the cross-section measurements for inelastic scattering made by Freeman. As for the cross-section energy distribution for ^{27}Al, ten peaks are shown. Seven of them are described in other works as energy levels of ^{28}Al having been obtained by total cross section: three of the last peaks are new peaks. The "J" values are given including the corresponding calculated corrections for the outgoing channels. (auth)

25486 INELASTIC GAMMA-RAY SCATTERING IN ^{87}Sr NUCLEI. Abrams, I. A.; Pelekis, L. L.; Taure, I. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 6, 95-6(1966). (In Russian).

An ^{87m}Sr isomer was obtained by inelastic scattering of ^{116m}I γ quanta on ^{87}Sr. The half life of the ^{87m}Sr isomer was 2.7 ± 0.2 hr, and the isomeric transition energy was 372 ± 10 keV. The cross section for formation of the isomeric state is $\delta = 1.5 \pm 0.4 \times 10^{-32}$ cm^2. (R.V.J.)

25487 STUDY OF THE REACTION ^{31}P(p,α_0)^{28}Si INDUCED BY PROTONS OF 1.4 TO 1.9 MeV. Vernotte, J.; Langevin, M.; Laurent, H. (Paris Univ.). J. Phys. (Paris), 27: 773-9(Nov.-Dec. 1966). (In French).

The yield of the reaction ^{31}P(p,α_0)^{28}Si was studied in the energy range 1.4 to 1.9 MeV. Seven resonances were observed. Angular-distribution measurements were carried out for four of these resonances. Angular-distribution analysis gives the following values for for J^π: E_p = 1.402 MeV (2^+, 3^-); E_p = 1.509 MeV (1^-); E_p = 1.642 MeV (0^+, 1^-); and E_p = 1.803 MeV (1^-). (auth)

25488 SPECTRA OF NICKEL ISOTOPES. Janot, M. F.; Monsonego, G. (Centre de Recherches Nucleaires, Strasbourg). J. Phys. (Paris), 27: 769-72(Nov.-Dec. 1966). (in French).

Spectra of the nickel isotopes are calculated with restriction to states of lowest seniority. Two schematic effective interactions are chosen: the delta interaction and the surface delta interaction. The results are obtained in the frame of conventional shell-model theory. (auth)

25489 EVIDENCE FOR A NEUTRON EXCESS IN THE SURFACE OF HEAVY NUCLEI FROM A K$^-$ MESON CAPTURE STUDY. Davis, D. H. (London Univ.); Lovell, S. P.; Csejthey-Barth, M.; Sacton, J.; Schorochoff, G.; O'Reilly, M. Nucl. Phys., B1: 434-7 (1967).

In this experiment the relative rates of production of charged Σ hyperons by the capture of K$^-$ mesons on neutrons and protons in the heavy (silver and bromine) and the light emulsion nuclei (carbon, nitrogen, and oxygen) were measured. From these results it is concluded that there is a large neutron excess present in the outermost regions of heavy nuclei. (auth)

25490 NEUTRON DISTRIBUTION IN THE SURFACE OF HEAVY NUCLEI. Burhop, E. H. S. (London Univ.). Nucl. Phys., B1: 438-48(1967).

A recent study of the capture of K^- mesons in light and heavy nuclei present in photographic emulsion has led to the conclusion that primary K^- interactions with neutrons are, relative to interactions with protons, approximately five times more probable in heavy than in light nuclei. The ratio M_0/M_1 of the K^--nucleon transition amplitudes in the T = 0 and T = 1 channels for hydrogen, deuterium, helium, and light and heavy nuclei are discussed, and it is shown that the increased number of interactions on neutrons in heavy nuclei is unlikely to be attributable to changes in the transition amplitudes with nuclear binding energy but has rather to be explained in terms of an increased neutron to proton ratio in the nuclear periphery where K^- capture mainly occurs. Various proton and neutron distributions are discussed and it is shown that the magnitude of the effect could be understood if, for instance, in a heavy nucleus, the protons and neutrons had a distribution of Fermi shape with the same half-density radius but with the neutron surface thickness 50% greater than that of the proton distribution. Other experimental evidence for a neutron rich atmosphere in heavy nuclei, as suggested by Johnson and Teller, is briefly reviewed and the value of K^- capture studies in different materials as a sensitive means of investigating the neutron distribution in the nuclear surface is discussed. (auth)

25491 EXCITED-STATE g FACTORS IN ^{18}F AND ^{22}Na. Schmidt, H.; Morgenstern, J.; Koerner, H.; Braunsfurth, J.; Skorka, S. J. (Univ., Hamburg). Phys. Lett., 24B: 457-8 (May 1, 1967).

The spin rotation method was used to determine the nuclear g factors of the 1.125-MeV state of ^{18}F and the 0.587-MeV state of ^{22}Na. The measurements yielded g = +0.572 ± 0.006 and g = +0.555 ± 0.017, respectively. (auth)

25492 ATTENUATED DOPPLER SHIFT LIFETIME MEASUREMENTS IN PROTON CAPTURE REACTIONS. Carlson, L. E.; Azuma, R. E. (Univ. of Toronto). Phys. Lett., 24B: 462-3(May 1, 1967).

The Doppler shift attenuation method was used for the measurements of lifetimes of nuclear states excited in proton capture reactions. A 20 cm^3 Ge(Li) detector was employed to obtain the experimental energy shifts and the results of a calculation of Blaugrund were used to analyze the results. Lifetime results for five levels produced in the reaction $^{27}Al(p,\gamma)^{28}Si$ were obtained. (auth)

25493 THE $^{46,48,50}Ti(^3He,\alpha)$ REACTIONS AND ANALOG STATES IN T = ½ ISOBARIC PAIRS. Rosner, B.; Pullen, D. J. (Univ. of Pennsylvania, Philadelphia). Phys. Lett., 24B: 454-6 (May 1, 1967).

States in $^{45,47,49}Ti$, which are analogs to the $^7/_2^-$ ground states and the $^3/_2^+$, $^1/_2^+$ hole states in $^{45,47,49}Sc$, respectively, are studied by means of the $(^3He,\alpha)$ reaction. Good agreement is found between the energy sequences for the T = ½ isobaric pair, whereas discrepancies of 30 keV and 60 keV are observed in the energy sequences for the T = ⅚ and T = ⅔ pairs, respectively. (auth)

25494 STUDY OF SOME ^{20}Ne LEVELS BY RADIATIVE CAPTURE. Litherland, A. E.; Ollerhead, R. W.; Smulders, P. J. M.; Alexander, T. K.; Broude, C.; Ferguson, A. J.; Kuehner, J. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 45: 1901-10(May 1967). (AECL-2884).

Four resonances in the reactions $^{16}O(\alpha,\gamma)^{20}Ne$ and $^4He(^{16}O,\gamma)^{20}Ne$ were studied using gas targets of oxygen and helium. Resonances at 5.374, 6.930, and 7.940 MeV alpha-particle bombarding energy had been observed previously using the first reaction. In this experiment, an additional resonance was found at 5.075-MeV alpha-particle bombarding energy. This resonance level decays by a prominent cascade of gamma rays through the 4+, 4.25-MeV level in ^{20}Ne and can be identified with a 6+, 8.79-MeV level in ^{20}Ne observed previously in the $^{12}C(^{12}C,\alpha)^{20}Ne$ reaction. A comparison of the yield of the new resonance with one previously reported gives a value of $\omega\gamma = 1.8 \pm 0.4$ eV, which implies an E2 strength of 28 ± 6 Weisskopf units for the 6+ to 4+ transition. (auth)

25495 SPECTROSCOPY OF PROTONS FROM NUCLEAR REACTIONS WITH 14-MeV NEUTRONS WITH A COUNTER TELESCOPE. Emmerich, W.-D.; Hofmann, A. (Univ., Erlangen-Nuremberg). Z. Phys., 201: 241-9(1967). (In German).

Protons from nuclear reactions induced by 14-MeV neutrons were studied by means of a telescope, consisting of three CO_2-flow counters and a surface-barrier detector. The resolving power of this arrangement, tested with recoil protons was found to be 400 keV at 14 MeV, the efficiency (counts per incident neutron) being 3×10^{-7}. From the measured energy spectra of the protons from the metals Ti, Fe, Ni, and Zn in the forward direction, statistical theory parameters were evaluated. In the level-density expression $\rho(E_a) \sim E_a^{-n} \exp(2\sqrt{aE_a})$ the exponent n = 2, including angular momentum effects, is found to be in better agreement with the experimental data than other n-values frequently used. (auth)

25496 THE HALF-LIFE OF ^{42}K. Goodier, I. W. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop., 18: 334-5(May 1967).

Potassium-42 is prepared by the $^{41}K(n,\gamma)$ reaction, but even the purest potassium compounds contain traces of sodium, which yield ^{24}Na as impurity. For this reason, early measurements of ^{42}K half life, employing no radiochemical separation of Na and K, were almost certainly in error. Using an ion exchange separation process, the value 12.358 ± 0.007 hr was obtained for the half life. A check on this value is described, using the tetraphenyl boron potassium precipitation process for the separation (the efficiency of this separation was found to be better than 99.999%). Potassium-42 was obtained with a maximum ^{24}Na impurity of 0.02 ppm. Decay of the ^{42}K was followed using a $4\pi\beta$ proportional counter. The mean value for the half life of ^{42}K was calculated to be 12.361 ± 0.009 hr. (UK)

25497 NUCLEAR g FACTORS OF THE FIRST EXCITED STATES OF ^{76}Se AND ^{122}Te. Murray, J.; McMath, T. A.; Cameron, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 45: 1821-31(May 1967).

The nuclear g factors of the first excited states of ^{76}Se and ^{122}Te were measured by observing the rotation of gamma-ray angular correlations. The perturbing magnetic fields used were the internal fields in dilute iron alloys. The values obtained for the g factors are ^{76}Se, 559 keV; g = +0.40 ± 0.12 and ^{122}Te, 564 keV; g = +0.35 ± 0.07. (auth)

25498 STUDY OF THE GAMMA RADIATION FOLLOWING THERMAL NEUTRON CAPTURE BY SILICON. Lycklama, H.; Hughes, L. B.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 45: 1871-84(May 1967).

A study of the gamma radiation following thermal neutron capture by natural silicon was conducted. Precise energy measurements were obtained using a Ge(Li) counter, and a decay scheme was constructed using the time correlation results obtained with a Ge(Li)–NaI(Tl) spectrometer. The neutron separation energy was found to be 8474 ± 1 keV for ^{29}Si. An examination of the reduced radiation widths revealed that, while E1 and E2 radiation agreed well with the single-particle estimate, the M1 strength was hindered by a factor of from 10 to 100. (auth)

25499 THE GROUND STATE PROPERTIES OF ^{25}Na. Das Gupta, S. (McGill Univ., Montreal). Nucl. Phys., A97: 481-7 (1967).

The spin of the ground state of ^{25}Na and its β decay to the low-lying levels of ^{25}Mg are investigated by the Hartree–Fock model. (auth)

25500 DECAY OF ^{55}Cr. Pratt, William W. (Pennsylvania State Univ., University Park). Nucl. Phys., A97: 505-9(1967).

The beta decay of ^{55}Cr was found to be followed by gamma rays with energies of 1.521 ± 0.006 and 2.240 ± 0.012 MeV. The intensities of these gamma rays were measured, with an error of about 50%, to be 5.8×10^{-5} photons/dis and 4.6×10^{-6} photons/dis, respectively. It is inferred from these and associated coincidence measurements that beta decay transitions proceed to states in ^{55}Mn at 1.521 and 2.240 MeV with log ft values of 7.5 ± 0.3 and 6.6 ± 0.3, respectively. (auth)

25501 ON THE COLLECTIVE OCTUPOLE STATE OF ^{88}Sr. Shastry, S.; Saha, A. K. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., A97: 567-71(1967).

A finite-range force calculation was performed to explain the collective character of 2.76-MeV 3^- octupole state of ^{88}Sr. The ratio of experimental to theoretical transition probability is 1.96. (auth)

25502 POSITIVE-PARITY LEVELS OF EVEN NUCLEI. de Aisenberg, E. Y.; Suarez, J. F. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Phys., A97: 529-40(1967).

The energy of positive-parity levels of some even nuclei were compared with the predictions of Davydov's model including the coupling between the rotations and the β and γ oscillations. The parameters involved have a trend in the (N,Z) plane which shows that nuclei lying away from N and Z magic numbers are axially symmetric and are predominantly of the rotational type. Nuclei with N or Z near magic numbers are axially asymmetric and present a strong interaction between rotations and surface vibrations. Most of the known levels can be considered as collective excitations. (auth)

25503 PROTON SPIN-FLIP IN INELASTIC SCATTERING ^{52}Cr AND ^{54}Fe. Ballini, R.; Cindro, N.; Delaunay, J.; Fouan, J.;

Loret, M.; Passerieux, J. P. (CEN, Saclay, France). Nucl. Phys., A97: 561-6(1967).

Proton spin-flip at 11 MeV was measured by the (p,p'γ) technique on the first 2^+ level of ^{52}Cr (Q = −1.43 MeV) and the three lowest 2^+ levels in ^{54}Fe (Q = −1.41, 2.96, and 3.16 MeV). Comparisons of the measurements are made with the predictions of the collective model. Only the fit for the second 2^+ in ^{54}Fe (Q = −2.96 MeV) is acceptable. (auth)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 24050, 25392, 25393, 25465, 25477, 25479, 25489, 25490, 25497, 25502, and 25570.

25504 (EANDC(E)-74(U)) NEUTRON CROSS SECTIONS AND FISSION PARAMETERS OF ^{240}Pu, ^{241}Pu, AND ^{242}Pu. Prosdocimi, A. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau. European-American Nuclear Data Committee). Aug. 25, 1960. 18p. Dep.

A compilation of neutron resonance integrals and parameters, values for the numbers of prompt neutrons emitted in neutron and spontaneous fission, and neutron fission and total cross sections is presented for ^{240}Pu, ^{241}Pu, and ^{242}Pu. (D.C.W.)

25505 (EURFNR-209F) MEASUREMENTS OF EFFECTIVE (RESONANCE-SHIELDED) NEUTRON CROSS SECTIONS IN THE keV REGION. Miessner, H.; Arai, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Oct. 1966. 16p. (KFK-451). Dep.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

Neutron absorption and transport cross sections were measured for Pb and ^{238}U at 30 keV and for ^{238}U at 7.5 keV by observing the decay of short pulses of nearly monoenergetic neutrons in assemblies of Pb and U. (D.C.W.)

25506 (JINR-E7-3257) STUDY OF ALPHA-DECAY OF 103^{256} AND 103^{257}. Flerov, G. N.; Korotkin, Yu. S.; Mikheev, V. L.; Miller, M. B.; Polikanov, S. M.; Shchegolev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 9p. Dep.

It was shown that the isotope 103^{256} has a complicated alpha-spectrum in the range $8.35 \leq E_\alpha \leq 8.60$ MeV. A most intense group of alpha particles has E = 8.42 MeV. The measured half life for 103^{256} is about 35 sec. The experimental data obtained permit one to make some assumptions about alpha decay of 103^{257}. (auth)

25507 (JINR-E7-3261) ON PROPERTIES OF THE ISOTOPE 102^{251}. Akap'ev, G. N.; Demin, A. G.; Druin, V. A.; Flerov, G. N.; Korotkin, Yu. S.; Lobanov, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 8p. Dep.

The experimental data on the study of alpha-decay products of bombarding targets of ^{233}U, ^{235}U, and ^{239}Pu with ^{22}Ne, ^{20}Ne, and ^{16}O ions, respectively, are given. Experimental results indicate that the ^{251}No isotope has $T_{\frac{1}{2}} = 0.5$ to 1.0 sec and $E_\alpha = 8.6$ MeV. (auth)

25508 (JINR-P02-3201) KINEMATICHESKIE KHARAKTERISTIKI OSTATOCHNYKH YADER V KASKADNOM PROTSESSE PRI ENERGII PROTONOV 660 MeV. (Kinematic Characteristics of Residual Nuclei in Cascade Process at Proton Energy 660 MeV). Kochkin, V. I.; Lozhkin, O. V.; Mal'tseva, N. S.; Mal'tsev, V. M.; Yakovlev, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1967. 21p. (In Russian). Dep. mn.

The results of calculations of the kinematics and excitation energy distributions of nuclei which remain after the cascade process is completed are given. The dependencies calculated are compared with experiment. (auth)

25509 (JINR-P3-3208) OPREDELENIE SPINOV NEITRONNYKH REZONANSOV ^{165}Ho. (Determination of Spins of ^{165}Ho Neutron Resonances). Alfimenkov, V. P.; Lushchikov, V. I.; Nikolenko, V. G.; Taran, Yu. V.; Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1967. 12p. (In Russian). Dep.

The transmission of polarized neutrons through a polarized Ho target was measured by time-of-flight method with the help of a neutron spectrometer with a resolution of 25 ns/m. From these measurements the spins were determined for 18 excited states of the ^{166}Ho compound nucleus. (auth)

25510 (JINR-P6-3241) SPEKTR KONVERSIONNYKH ELEKTRONOV IZOTOPA ^{158}Ho. (Conversion Electron Spectra of ^{158}Ho). Gromov, K. Ya.; Mukhtasimov, F. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 8p. (In Russian). Dep.

The conversion electron spectra of ^{158}Ho were investigated using a permanent magnetic β spectrograph. In the study of ^{158}Ho decay, a number of new γ transitions were found; the multipolarity of a γ transition of the E2 type with the energy 320.6 keV is determined unambiguously. On the basis of these data, a scheme of ^{158}Dy excited levels is suggested, in which the levels with the energies 637.8(6.0$^+$); 994.5(0.0$^+$); 1084.8(2.0$^+$); 1278.6(4.0$^+$); 1314.2-(5.2$^+$); 1476.2(6.2$^+$); 1894.7(4.4$^+$); and 2056 keV are introduced into the decay mode of ^{158}Ho for the first time. (auth)

25511 (LA-DC-8640) ^{233}U CROSS SECTIONS AS DETERMINED USING NEUTRONS FROM A NUCLEAR DETONATION. Bergen, D. W. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 5p. (CONF-670602-1). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

Some measurements of the capture and fission cross sections of ^{233}U in which target foils were exposed to a moderated flux from a nuclear explosion are summarized. Relation fission cross sections are presented for energies of 20 to 10^6 eV, as well as information on the capture-to-fission ratio between 27 and 63 eV. The results of resonance analyses using both single-level and multi-level formalisms indicate that the fission of ^{233}U takes place through several channels. (D.C.W.)

25512 (MLM-698) RECOMMENDED VALUE FOR THE HALF LIFE OF POLONIUM. Eichelberger, J. F. (Mound Lab., Miamisburg, Ohio). Apr. 14, 1952. Contract AT(33-1)-Gen-53. 11p. Dep. CFSTI.

A survey was made of the various determinations of the half life of polonium. Fifteen measurements which were made in 1920 and subsequent years were considered to be reliable enough to warrant their inclusion on a weighted mean. Each weight was taken to be proportional to the inverse square of the corresponding probable error. An arbitrary weight was assigned to any determination for which no probable error was found. It was shown that the data are consistent; accordingly, they were combined by the appropriate formulas to give the mean and its probable error: 138.387 ± 0.022 days. (auth)

25513 (NASA-TN-D-3957) EFFECTIVE RESONANCE INTEGRALS OF SEPARATED TUNGSTEN ISOTOPES. Shook, Donald F.; Bogart, Donald (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 33p. CFSTI.

Measurements of effective resonance integrals for separated W isotopes enriched ^{182}W, ^{183}W, ^{184}W, and ^{186}W and for natural W were made relative to Au. The effective integrals were determined by using a small homogeneous reactor to measure epicadmium reactivities for samples of various sizes located at the center of the core. For comparison with the reactivity data, relative γ-ray activities of Cd-covered thin samples of Au were also determined. The experimental results were compared with effective resonance integral calculations by using the Nordheim integral method and recently measured isotopic resonance parameters. Agreement between the calculations and experimental results for ^{182}W, ^{183}W, and ^{184}W were generally good. However, for the ^{186}W samples and for thick samples of natural W the calculations overestimated experimental effective integrals by 10 to 20%. For ^{186}W, the use of a radiation width of 44 ± 4 milivolts for the highly scattering 18.8-eV resonance brought calculations and experiment into better agreement. For natural W, the experimental results indicated the presence of overlap effects for resonances of constituent isotopes. (auth)

25514 (NP-16672) DETERMINATION OF THE THREE CONVERSION COEFFICIENTS IN THE DECAY OF ^{198}Au WITH SEMICONDUCTOR COUNTERS. Bosch, H. E.; Szichman, E. (Instituto de Investigacione Aeronautica y Espacial, Buenos Aires (Argentina)). Dec. 1966. 18p. Dep. mn.

A setup for determining conversion coefficients by means of different arrangements of semiconductor detectors (both lithium-drifted silicon and germanium) and scintillation counters is presented. The conversion coefficients corresponding to the three transitions in ^{198}Hg were measured. Singles electron conversion and gamma spectra were recorded, deriving the value of the conversion coefficient for the 1.083-MeV transition taking into account the value obtained for that of the 0.412-MeV transition. Beta continuum-electron conversion coincidences were measured with two lithium-drifted silicon detectors, and the K-conversion coefficient for the latter transition was obtained. Gamma-gamma coincidences with a lithium-drifted germanium detector and a conventional scintillation counter were done, yielding the value of the K-conversion coefficient for the 0.671-MeV transition. The rela-

tive intensities of the gamma rays detected with a lithium-drifted germanium counter are given. (auth)

25515 (ORNL-TM-1751) MEASUREMENT OF THE NEUTRON FISSION AND CAPTURE CROSS SECTIONS FOR ^{233}U IN THE ENERGY REGION 0.4 TO 1000 eV. Weston, L. W.; Gwin, R.; deSaussure, G.; Ingle, R. W.; Fullwood, R. R.; Hockenbury, R. W. (Oak Ridge National Lab., Tenn.). Apr. 26, 1967. Contract W-7405-eng-26. 63p. Dep. CFSTI.

The neutron capture and fission cross sections for ^{233}U were measured simultaneously in the neutron energy range from 0.4 to 1000 eV. The data are presented in graphical, tabular, and integral form. Comparisons with previously published data, using similar and different methods, are given. (auth)

25516 (PUC-937-250) THE SPINS AND MOMENTS OF ^{117}Sb AND ^{118m}Sb. Jackson, Andrew D. Jr. (Princeton Univ., N. J. Palmer Physical Lab.). Mar. 1967. Contract AT(30-1)-937. 122p. Dep. CFSTI.

Thesis.

The spins and hyperfine structures (HFS) of ^{117}Sb (2.7 hr) and ^{118m}Sb (3.5 min) were determined using conventional atomic-beam magnetic resonance techniques. These isotopes were produced by (p,n) reactions on enriched tin targets in the Princeton University cyclotron. ^{117}Sb was made with the internal proton beam and was transferred to an off-line atomic-beam apparatus. ^{118m}Sb was produced directly in the oven chamber of an on-line beam apparatus using the external proton beam. The spin measurements gave $I_{117} = \frac{5}{2}$ and $I_{118m} = 1$. The measured HFS constants are $A_{117} = -237.8(2)$ MHz, $B_{117} = -5.4(4)$ MHz, and $|A_{118m}| = 545(24)$ MHz. The corresponding magnetic dipole and electric quadrupole moments are $\mu_{117} = +2.672(10)$ nm, $|\mu_{118m}| = 2.45(12)$ nm, and $Q_{117} = -0.29(3)$ b. The results of first-order configuration-mixing corrections to the magnet moments using both zero-range and realistic force matrix elements are discussed. (auth)

25517 (RFR-191) FAST ELASTIC AND INELASTIC CROSS SECTIONS FOR ^{238}U. Haggblom, H. (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 3, 1962. 28p. Dep.

Experimental and semi-empirical scattering cross sections for ^{238}U are compared with theoretical values in the energy range 0.08 to 6 MeV. The theoretical cross sections are obtained by optical-model calculations including spin-orbit interaction and by Hauser-Feshbach theory. Transport cross sections are calculated both from the experimental and the theoretical differential cross sections. Calculations of inelastic 11-group cross sections are performed using the continuum model for the compound nucleus in the region above 1.4 MeV and assuming five excitation levels below 1 MeV. Between 1.0 and 1.4 MeV, the cross-sections are obtained by taking a mean value between the results from the continuous and the discrete level theory. (auth)

25518 (WASH-1071) THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP MEETING AT ARGONNE, ILLINOIS, NOVEMBER 10-11, 1966. Motz, H. T. (comp.) (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. 234p. (EANDC(US)-91-U; INDC(US)-5-U). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The status of activities in the cross-section measurement program is summarized. Preliminary data are included. (D.C.W.)

25519 COULOMB DISPLACEMENT ENERGY SYSTEMATICS FROM CALCIUM TO SAMARIUM. Jaffe, A. A.; Harchol, M. (Hebrew Univ., Jerusalem). pp 230-2 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The available data are presented on Coulomb displacement energies (ΔE_c) for cases where the values of ΔE_c are known to an accuracy of better than 50 keV for atomic numbers of $19 < Z < 63$. The data were obtained in a variety of ways, including the study of analog resonances, (p,d) reactions, and (^{3}He,t) reactions. (S.F.L.)

25520 RESONANCE REACTIONS AND SPECTROSCOPY. von Brentano, P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 268-300 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A survey is given of reactions which are used to excite analog states in nuclei. These include elastic and inelastic proton scattering, (p,n), and (d,p) reactions. A collision matrix is given for interpreting the experiments in terms of generalized optical-model theory, which includes a brief discussion on resonance analysis. The results of some recent experiments on analog state spectroscopy are presented. This includes the reactions $^{92}Zr(p,p)$, $^{118}Sn(p,p)$, $^{118}Sn(p,p')$, $^{144}Sm(p,n)$, $^{93}Nb(p,n)$, $^{116}Sn(p,p)$, $^{138}Ba(p,p)$, $^{142}Nd(p,p')$, and $^{48}Ca(d,p)$. (S.F.L.)

25521 DECAY OF ISOBARIC ANALOGUE STATES IN THE LEAD REGION. Richard, P.; Kavaloski, C. D.; Lilley, J. S.; Stein, N. (Univ. of Washington, Seattle). pp 307-19 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Isobaric analogs of low-lying states of ^{207}Pb, ^{208}Pb, and ^{209}Pb have been observed in proton elastic and inelastic scattering excitation functions. A new feature observed in these data is that many of the (p,p') analog resonances have shapes quite different from the symmetric Breit-Wigner shapes observed in previous experiments with lighter nuclei at lower incident energies. This indicates the possible importance of another reaction mechanism which is competing with simple compound inelastic scattering via the analog state, so that the analysis of such data may be considerably more complicated than the Breit-Wigner single-level analysis. Excitation functions are presented for proton elastic and inelastic scattering by lead isotopes, and possible explanations for asymmetric resonance shapes are discussed. (S.F.L.)

25522 STUDY OF ISOBARIC-ANALOGUE STATES BY PROTON SCATTERING ON Ba ISOTOPES. Morrison, G. C.; Vager, Z. (Argonne National Lab., Ill.). pp 320-32 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The isobaric analogs of some low-lying states in Ba isotopes were observed as compound-nucleus resonances in elastic and inelastic proton scattering by ^{134}Ba, ^{135}Ba, ^{136}Ba, ^{137}Ba, and ^{138}Ba. The neutron configurations in the even Ba isotopes are given. The experimental data for elastic proton scattering at 170° and the excitation functions of the five Ba isotopes are given in the energy range 9.0 to 11.4 MeV. Optical-model cross sections are plotted which fit the data well at lower energies. (S.F.L.)

25523 SPIN AND PARITY MEASUREMENTS FOR ANALOGUE RESONANCES IN $^{90}Zr(p,p)$. Terrell, G. (Univ. of Texas, Austin); Moore, C. F.; Adams, J. L.; Robson, D. pp 333-51 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Double scattering techniques were used to measure the polarization of protons elastically scattered by ^{90}Zr for proton energies between 6.6 and 7.1 MeV. This region contains a resonance previously identified as an isobaric analog state in the compound nucleus ^{91}Nb. The polarization study of the analog state serves to measure the spin in a direct fashion which can be analyzed using model-independent techniques. Also, the magnitude and shape of the polarization excitation curve adds information to the measurements of resonance parameters made on the differential cross section. (S.F.L.)

25524 ANALOGUE STATES IN Pb ISOTOPES. Adam, A.; Bassani, G.; Cindro, N.; Levi, C.; Mermaz, M.; Papineau, L. (CEN, Saclay, France). pp 366-72 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The ^{206}Pb and ^{207}Pb elastic and inelastic scattering excitation functions were obtained by bombarding isotopically enriched Pb targets with the proton beam of the Saclay Tandem Van de Graaff accelerator. Resonances corresponding to the analogs of the ^{207}Pb and ^{208}Pb ground states were clearly observed in the elastic scattering. The energy of the resonances and their total widths were obtained from the inelastic excitation functions. (S.F.L.)

25525 SEARCH FOR ISOBARIC ANALOGUE RESONANCES INDUCED BY DEUTERONS. Hamburger, E. W. (Univ. of Pittsburgh). pp 464-71 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

In an effort to observe isobaric analog resonances induced by deuterons, targets of ^{141}Pr, ^{194}Pt, and ^{209}Bi were bombarded in the energy region where isobaric analog resonances were expected (4.1, 6.8, and 11.1 MeV, respectively). The reaction $^{207}Pb(d,p)^{208}Pb$ was also studied with greater precision than had previously been used. Data for this reaction are given near the lowest resonance for the transition to the ^{208}Pb ground state and to the unresolved doublet at 3.198 to 3.475 MeV excitation energy. (S.F.L.)

25526 (p,n) REACTION ON ^{91}Zr FOLLOWED BY PROTON EMISSION. Yavin, A. I.; Hoffswell, R. A.; Noweir, T. M. (Univ. of Illinois, Urbana). pp 584-94 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Protons from the decay of $^{91}Nb^*$ (the analog of the ground state of ^{91}Zr) were observed following the reaction $^{91}Zr(p,n)^{91}Nb^*$ as a means of investigating Coulomb displacement energy. Once the energy of protons from the decay of $^{91}Nb^*$ is known, the Coulomb displacement energy E_c may be determined from the relation: $E_c = \Delta E + T + \delta$, where $\Delta E = E(^{90}Zr + p) - E(^{91}Zr)$, $T = T(p) + T(^{90}Zr)$ is the total kinetic energy in the $^{91}Nb^*$ system, and δ is the neutron-proton mass difference in energy units. Preliminary results indicate that the technique used is an accurate tool for the determina-

tion of Coulomb displacement energies. The Coulomb displacement energy (11.90 ± 0.10 MeV) obtained for ^{91}Zr is in good agreement with the value of 11.75 ± 0.15 MeV measured by Anderson, et al., for Zr. (S.F.L.)

25527 ISOBARIC ANALOGUE STATES OF ^{119}Sn AND ^{121}Sn. Allan, D. L.; Jones, G. A.; Morrison, G. C.; Taylor, R. B.; Weinberg, R. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 689-700 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Both ^{118}Sn and ^{120}Sn have a strong 2^+ collective state at approximately 1.2 MeV and a strong 3^- collective state at approximately 2.35 MeV. The elastic and inelastic scattering of protons to these two states was studied at incident proton energies of 7.3 to 11.1 MeV for ^{118}Sn and 7.3 to 10.3 MeV for ^{120}Sn. Excitation functions are given for both scattering reactions. (S.F.L.)

25528 EXCITATION OF ISOBARIC ANALOGUE STATES BY ELASTIC PROTON SCATTERING FROM TARGET NUCLEI WITH N = 82. Wurm, J. P.; von Brentano, P.; Grosse, E.; Seitz, H.; Wiedner, C. A.; Zaidi, S. A. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 790-7 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Excitation functions of the differential cross section for elastic scattering of protons from the target nuclei ^{140}Ce, ^{142}Nd, and ^{144}Sm were measured in the incident-proton energy ranges of 9.5 to 12 MeV, 9 to 11.4 Mev, and 8.6 to 11.7 MeV, respectively. Spectroscopic factors were compared with those from corresponding (d,p) reactions. (S.F.L.)

25529 ISOBARIC ANALOGUE RESONANCES OBSERVED IN THE INELASTIC SCATTERING OF PROTONS FROM ^{138}Ba, ^{140}Ce, ^{142}Nd, AND ^{144}Nd. Zaidi, S. A. A.; von Brentano, P.; Melchior, K.; Rauser, P.; Wurm, J. P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 798-806 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The excitation functions of the inelastic proton scattering on the nuclei ^{138}Ba, ^{140}Ce, ^{142}Nd, and ^{144}Nd were obtained at proton bombarding energies of 9.7 to 11.4 MeV, 9.5 to 11.7 MeV, 9.4 to 11.4 MeV, and 9.2 to 11.1 MeV respectively. These functions show very strong resonances corresponding to the excitation of isobaric analog states. (S.F.L.)

25530 ISOBARIC ANALOGUE STATES IN ^{90}Zr. Black, J. (Oxford Univ.); Islam, M. M.; Jones, G. A.; Morrison, G. C.; Taylor, R. B. pp 863-80 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Detailed studies were made of the excitation functions of the reactions ^{89}Y(p,γ_0)^{90}Zr, ^{89}Y(p,n)^{89}Zr, ^{89}Y(p,n)^{89m}Zr, ^{89}Y(p,p')^{89m}Y, and ^{89}Y(p,γ)^{90m}Zr at proton energies in the range 4.7 to 6.4 MeV for all reactions. These measurements reveal many more isobaric analog states than do elastic scattering measurements and demonstrate that the study of the proton elastic scattering function alone is not sufficient as a tool for investigating low-lying excited states of the analog nucleus. (S.F.L.)

25531 MAGNETIC HYPERFINE INTERACTION IN ^{121}Sb USING THE MOESSBAUER EFFECT. Ruby, S. L.; Kalvius, G. M. (Argonne National Lab., Ill.). Phys. Rev., 155: 353-5(Mar. 10, 1967).

The Mössbauer resonance in ferromagnetic MnSb was observed at 4.2°K. Using the ground-state interaction as given by NMR, the value $g_{3/2}/g_{5/2}$ = 0.498 ± 0.005 was obtained. Substituting +3.359 nm as the $^5/_2$ moment gives +2.35 ± 0.03 nm for the $^3/_2$ state. (auth)

25532 THE INTERNAL CONVERSION ELECTRON SPECTRUM OF ^{147}Nd. Bashandy, E.; El-Haliem, A. Abd (Atomic Energy Establishment, Cairo). Z. Naturforsch., 22a: 154-64(Feb. 1967).

The internal conversion electron spectrum following the β-decay of ^{147}Nd was studied using an iron yoke and an iron free double focussing β-ray spectrometer at a momentum resolution of about 0.2%. A total of 66 transitions was ascribed to this decay. On the basis of statistical analysis of sum relationships for the transition energies, combined with earlier reported coincidence results, a decay scheme involving 16 excited levels in ^{147}Pm is suggested. The experimental data indicate a higher state at 763 keV. Its energy is close to the high state observed in other promethium nuclei. The multipolarity assignment for each transition was obtained by comparing the observed conversion line intensity ratios with the theoretical line intensity ratios of Sliv and Band. From the multipolarity values obtained, the spins and parities of the excited levels in ^{147}Pm are assigned and discussed in terms of recent nuclear models. (auth)

25533 NUCLEAR CHEMISTRY RESEARCH AT CERN. Rudstam, G. (Forskningsradens Laboratorium, Studsvik, Nykoping, Sweden). Svensk Kem. Tidskr., 78: 618-32(1966). (In Swedish).

The facilities at CERN for nuclear chemistry research and a survey of the experimental program within nuclear chemistry are outlined. The accelerators, laboratories, and instrumentation are described. A brief review of experimental techniques in the study of nuclear reactions is given. A description of studies of nuclear reactions with complicating effects, e.g., production with kinetic energy, spin, or angular momentum, is given, with illustrations of the distributions in iodine isotopes produced by irradiation of U, Ta, Au, and La with 18-GeV protons. Other reactions involving the production of mesons(π) on bombardment are also under study, particularly those involving ^{65}Cu and ^{103}Rh. Nuclear reactions induced by mesons and antiprotons are also discussed. Nuclear spectroscopic experiments are noted, as are the plans for the ISOLDE project. (BBB)

25534 THE LOW-LYING STATES OF THE NUCLEI ^{186}Re AND ^{188}Re FROM (n,γ) REACTION. Prokof'ev, P. T.; Simonova, L. I. (Inst. of Physics, Riga). Yadern. Fiz., 5: 697-700(Apr. 1967). (In Russian).

The spectra of conversion electrons emitted in the capture of thermal neutrons by ^{185}Re and ^{187}Re nuclei were studied by means of a β-spectrometer. There were 64 lines in the ^{186}Re spectrum and 27 lines in the ^{188}Re spectrum found in electron energy range 35 to 250 KeV. The schemes of the low-lying excited states of ^{186}Re and ^{188}Re are proposed on the basis of the values of the transition energies, intensities, multipolarities as well as of previous results. The schemes consist of ground rotational bands $K^\pi = 1^-$ and two-particle states 1^-, 3^-, 4^-. Moreover there is a level 4^+ in the scheme of ^{188}Re. (auth)

25535 CALCULATION OF NUCLEAR DEFORMATIONS FROM ISOTOPIC SHIFTS. Golovin, A. F. Yadern. Fiz., 5: 755-8(Apr. 1967). (In Russian).

Deformation parameters, internal quadrupole moments and probabilities of electric quadrupole transitions from the ground state to the first excited state are found from the experimental data on isotopic shifts in the atomic spectra for eight rarely distributed even-even nuclei, for which there are no Coulomb measurements of these quantities. (auth)

25536 ANGULAR SPECTRA OF NEUTRONS IN THE TERNARY FISSION OF ^{235}U. Ivanov, O. I.; Kroshkin, N. I.; Nefedov, V. N.; Kharin, V. P. Yadern. Fiz., 5: 737-40(Apr. 1967). (In Russian).

Measured neutron angular spectra from ternary fission are presented. The time-of-flight method was used with time resolution Δt = 3 nsec. The flight path was 30 cm. The average energy of neutrons from ternary fission is shown to be equal to 2.2 MeV as compared to 2.34 MeV of neutron binary fission. It is found that the angular distributions from ternary and binary fissions are identical within the experimental errors. (auth)

25537 DEPENDENCE OF THE γ RADIATION ANISOTROPY AT THE THERMAL NEUTRON FISSION OF ^{235}U ON THE RATIO OF FRAGMENT MASSES. Val'skii, G. V.; Petrov, G. A.; Pleva, Yu. S. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 5: 734-6(Apr. 1967). (In Russian).

The ratio of the intensities of γ-rays emitted at the thermal neutron fission of ^{235}U at angles of 30 and 90° to the direction of the separation of fragments is investigated. This ratio is found to depend rather weakly on masses of the created fragments. However, in the region corresponding to the heavy fragment mass $M_H \approx$ 130–135 a feebly marked wide minimum is observed. (auth)

25538 DIRECTIONAL CORRELATIONS IN ^{124}Te. Meder, M. R.; Durham, F. E. (Tulane Univ., New Orleans). Nucl. Phys., A97: 78-80(1967).

Directional correlations for the 1690–603 keV cascade in ^{124}Te were measured. The results are $A_2(\gamma\text{-}\gamma) = -0.074 \pm 0.004$; $A_2(\gamma\text{-}e^-K) = -0.121 \pm 0.022$; $A_2(\gamma\text{-}e^-LM) = -0.104 \pm 0.060$. The K-shell particle parameter for the 603-keV transition as determined from these correlations is in good agreement with the theoretical point-nucleus prediction for a pure E2 transition. (auth)

25539 ON THE SPIN ASSIGNMENT OF NEUTRON RESONANCES IN ^{149}Sm USING (n,α) REACTION. Dakowski, M.; Krogulski, T.; Piasecki, E.; Piekarz, H.; Sowinski, M. (Inst. of Nuclear Research, Warsaw). Nucl. Phys., A97: 187-92 (1967).

Measurements of thermal-neutron cross sections for the ^{149}Sm(n,α)^{146}Nd reaction were made using a 99% enriched ^{149}Sm target. Results are compared with theoretical values of cross sections calculated on the basis of the compound nucleus and statistical models. Experimental and calculated values are con-

sistent only when assuming that the spins of the bound state and the 0.0967-eV resonance in ^{149}Sm + n are 3$^-$ and 4$^-$, respectively. For such a spin sequence, the 2200-m/sec experimental neutron cross sections are: 46.0 ± 5 mb for ^{149}Sm(n,α)^{146}Nd$_{2+}$ and 8.5 ± 1.5 mb for ^{149}Sm(n,α)^{146}Nd$_{0+}$. (auth)

25540 RADIOACTIVITY OF IRRADIATED Th FUELS BECAUSE OF THE FORMATION OF ^{232}U AND ^{228}Th. Schlosser, Gerhard; Behrens, Ernst (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 9: 36-42(Jan. 1967). (In German).

The formation of the isotopes ^{232}U and ^{228}Th by (n,2n) processes in repeated introductions of Th and U into a reactor was investigated. The natural decay of ^{228}Th leads through the gaseous ^{220}Rn to the strongly γ active nuclides ^{212}Bi and ^{208}Tl. The activity pattern (which depends on the radiation time and Th storage time) during fuel element processing was given for several cycles, which determines the necessary shielding. (tr-auth)

25541 CUMULATIVE YIELDS OF ^{99}Mo, ^{105}Rh, AND ^{132}Te IN THE SPONTANEOUS FISSION OF ^{238}U. Jadhav, A. V.; Ramaniah, M. V.; Rao, C. L.; Shahani, C. J. (Atomic Energy Establishment, Trombay, India). Nukleonik, 9: 43-6(Jan. 1967).

Activities of ^{99}Mo, ^{105}Rh, and ^{132}Te in equilibrium with natural uranium were separated, and their cumulative yields in the spontaneous fission of ^{238}U were calculated using Segre's value of 8.04 ± 0.3 × 10^{15} yr for the spontaneous fission half life of ^{238}U, and values of 6.94 ± 1.02, 1.15 ± 0.18, and 4.0 ± 0.6%, respectively, were found for the above nuclides. (auth)

25542 DECAY OF THE 395 μsec ISOMER OF ^{150}Tb AND THE 2.53 msec ISOMER OF ^{208}Bi. Hilscher, H.; Korthaus, E.; Krebs, W. D. (Univ., Heidelberg). Nucl. Phys., A97: 52-64(1967). (In German).

The decay of the 395-μsec isomer in ^{150}Tb and the 2.53 msec isomer in ^{208}Bi, produced by 25 MeV bremsstrahlung, was investigated by a coincidence technique. It is argued that the isomer in ^{150}Tb is probably a K = 1, $J^\pi = 7^-$ state with the proton in the $^3/_2$+ [411] and the neutron in the $^{11}/_2^-$ [505] Nilsson state decaying via a K = 3 rotational band. The isomer in ^{208}Bi probably has a $J^\pi = 10^-$ spin assignment. (auth)

25543 MEASUREMENT OF THE 0.8 s HALFLIFE OF ^{207m}Pb BY THE TECHNIQUE OF DELAYED γ-γ COINCIDENCES. Radeloff, J.; Schaefer, G. (Univ., Bonn). Nucl. Instrum. Methods, 51: 351-2(May 1967).

The 0.8 s half life of ^{207m}Pb was reinvestigated by the technique of delayed γ-γ coincidences. For the reason of 4π geometry for both the γ_1- and γ_2-radiations only one scintillation detector was employed. (auth)

25544 PHOTONEUTRON PRODUCTION FROM 34- AND 100-MeV ELECTRONS IN THICK URANIUM TARGETS. Alsmiller, R. G. Jr.; Moran, H. S. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 51: 339-40(May 1967). (ORNL-TM-1670).

The number of photoneutrons produced by 34- and 100-MeV electrons in targets of natural uranium and of ^{238}U are calculated as a function of target thickness. For ^{235}U the number of neutrons produced by photofission is calculated separately. In the calculations only photoproduction is considered; that is, no attempt is made to correct or account for neutron-induced fission in the target. (auth)

25545 PRECISE SHAPE OF β SPECTRA AND BACK-SCATTERING BY THE SOURCE BACKING. Liaud, P.; Andre, S.; Depommier, P. (Univ., Grenoble, France. Centre d'Etudes Nucleaires, Grenoble, France). J. Phys. (Paris), 27: 654-6 (Nov.-Dec. 1966). (In French).

Using a Siegbahn-Slätis beta spectrometer the effect of backscattering by source backings on the shape of beta spectra was studied. It is concluded that the experimentally observed deviations of many beta spectra can not be explained solely by the backscattering effect. (auth)

25546 PRODUCTION OF NUCLEAR ISOMER ^{199m}Hg BY PHOTOACTIVATION IN INDIUM-GALLIUM RADIATOR. Abrams, I. A.; Pelekis, L. L.; Taure, I. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 6, 3-6 (1966). (In Russian).

The isomer ^{199m}Hg was obtained by the inelastic scattering of ^{115m}In gamma rays from Hg. The transition energy and half life of the isomer were determined as well as the activation cross section for ^{115m}In gamma rays. (D.C.W.)

25547 COLLECTIVE 1$^-$ EXCITATIONS INVOLVING A CHARGE EXCHANGE. Petersen, D. F.; Veje, C. J. (Univ. of Copenhagen). Phys. Lett., 24B: 449-53(May 1, 1967).

In heavy nuclei the existence of a new, so far unobserved, giant dipole-like state of neutron hole–proton type is suggested. The state is not in a simple way related to the ordinary giant dipole state. (auth)

25548 ON BETA$^-$ DECAY OF ^{182}Ta WITH ENERGY ABOVE 600 keV. Balalaev, V. A.; Voinova, N. A.; Dzhelepov, B. S.; Moskvin, L. N.; Shestopalova, S. A. (All-Union Scientific Research Inst. of Metrology, Leningrad. Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 126-31 (Jan. 1966). (In Russian).

A continuous background in the 820-keV region for the beta decay of ^{182}Ta was discovered previously. This prompted a continuation of the work to investigate the hard beta$^-$ radiation in the 1500-keV region of a stronger ^{182}Ta source. Results are plotted in curves, tabulated, and compared with other results. (JPRS)

25549 CONCERNING THE ANOMALOUS CONVERSION OF THE 59,6 keV TRANSITION IN ^{237}Np. Kondrat'ev, L. N.; Tret'yakov, E. F. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 132-4(Jan. 1966). (In Russian).

The L-subshell internal conversion coefficients for the 59.6-keV transition in ^{237}Np were measured using the double toroidal beta spectrometer and a scintillation counter. The absolute values of the conversion coefficients were determined from the intensity ratio of the L59.6 and M33.2 conversion lines. The internal conversion coefficients for the 59.6-keV transition and the values for the ratios of the L-subshell conversion coefficients for this transition are given. (J.F.P.)

25550 THREE-PARTICLE ISOMERIC STATES WITH SMALL SPIN. Peker, L. K.; Kharitonov, Yu. I. (Ioffe Inst. of Physics and Tech., Leningrad. Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 144-7(Jan. 1966). (In Russian).

Silvola et al. (J. Nucl. Phys., 52: 449(1964)) showed the existence of a long-lived alpha-radioactive isomeric state in ^{201}Bi with small spin. Due to the similarity in decay characteristics of ^{201}Bi to $^{195-203}$Bi one may suppose that the latter also have small spin. Experimentally it was observed that the ground states of $^{199-209}$Bi are $^9/_2$, and no spin of $^1/_2$ exists for the lowest single-particle proton levels. Consequently, the observed isomeric levels with spin $^1/_2$ must be from multiple-particle states. The energy of the level indicates that not more than 3 particles are involved, and it is improbable that all are nucleons and/or protons. Considerations involved in the problem are discussed in detail. (JPRS)

25551 INTERNAL CONVERSION SPECTRUM INCIDENT TO SLOW NEUTRON CAPTURE BY ^{197}Au NUCLEI. Pelekhov, V. I.; Shadiev, N. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 156-61(Jan. 1966). (In Russian).

The results are given of an investigation of the internal conversion electrons from neutron capture by ^{197}Au, which was undertaken to determine the multipolarities of some of the transitions in ^{198}Au. The conversion electron spectrum was measured with a resolution of about 1% over the electron energy range from 100 to 500 keV. The energies and relative intensities of these lines are listed. (J.F.P.)

25552 CONVERSION ELECTRON SPECTRUM OF AN IRIDIUM FRACTION. Sychikov, G. I.; Kovrigin, O. D.; Latyshev, G. D.; Londarenko, G. A.; Novikov, V. N. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 162-6(Jan. 1966). (In Russian).

A large double-focusing magnetic beta spectrometer was used to study the iridium fraction of a gold target irradiated with 660 MeV protons. The energies and relative intensities of the conversion lines of ^{189}Ir and ^{190}Ir are tabulated. Lines were observed for ^{188}Ir, ^{189}Ir, ^{190}Ir, and ^{193}Ir but not for ^{192}Ir, which fact is explained as due to the weakness of the source. The effects on the spectrum of traces of ^{185}Re and ^{188}Pt are discussed. The multipolarity of transitions 180.5, 147.0, 185.9, 197, and 233.5 keV was determined. Results, in general, agree with available data. (JPRS)

25553 INTERNAL AND EXTERNAL CONVERSION STUDIES ON THE DECAY OF ^{143}Ce. Bashandy, E.; Hanna, S. G.; El-Haliem, A. Abd (Atomic Energy Establishment, Cairo). J. Phys. Soc. Jap., 22: 960-71(Apr. 1967).

The internal-conversion and photoelectron spectra associated with the decay of ^{143}Ce to ^{143}Pr were studied using high-resolution double focusing beta spectrometers. In addition to gamma rays previously reported, five other gamma rays were observed. A decay scheme involving q excited levels is suggested for ^{143}Pr. The gamma intensities were determined by photoelectron experiments. The internal K-conversion coefficients of all the transitions above 200 keV following the decay of ^{143}Ce were determined absolutely by the method of comparing internal and external conversion lines. Multipolarity data, obtained from the absolute or ratio measurements of conversion coefficients, were utilized for assigning possible spins and parities to the levels of ^{143}Pr. The experimental level structure of ^{143}Pr is compared with theoretical predictions. (auth)

25554 UNSUCCESSFUL SEARCH FOR 17.5 DAY TO 22 DAY ^{141}Sm. Ladenbauer-Bellis, I. M. (Yale Univ., New Haven). Contract AT(30-1)-2726. Radiochim. Acta, 6: 215(Dec. 1966). (YALE-2726-H-89).

An attempt was made to observe the production of ^{141}Sm with a half life of 17.5 to 22 days in the reactions ^{133}Cs(N-14,6n) and ^{127}I(F-19,5n). Targets of $CsNO_3$ and NaI were bombarded with 10.5-Mev/nucleon ^{19}F and ^{14}N beams, and a search was made for the daughter activities that would have resulted if ^{141}Sm with a half life of about 20 days had been produced. It was concluded that ^{141}Sm does not have a half life of 17.5 to 22 days, but possibly has a half life that is shorter than 3 days. (D.C.W.)

25555 THE GAMMA SPECTRUM OF ^{145}Pr. Bullock, R. J.; Large, N. R. (Atomic Energy Research Establishment, Harwell, Eng.). Radiochim. Acta, 6: 201-6(Dec. 1966). (AERE-R-5170).

The γ spectrum of ^{145}Pr was investigated up to 1.5 MeV, and the abundances of the γ rays were determined. Peaks were observed at 0.0723 (0.20%), 0.674 (0.51%), 0.749 (0.43%), 0.979 (0.18%), 1.054 (0.17%), and 1.155 (0.15%) MeV. A peak at 1.45 MeV may be associated with ^{145}Pr but this has not been confirmed. (auth)

25556 THE HALF LIFE AND FORMATION CROSS SECTION OF ^{177m}Lu. Nethaway, D. R.; Mendoza, B. (Univ. of California, Livermore). J. Inorg. Nucl. Chem., 29: 865-7(Apr. 1967). (UCRL-70048).

The beta and gamma decay of a sample of ^{177m}Lu was followed for a period of 3 yr. The half life was found to be 161.0 ± 0.3 days. The cross section for the ^{176}Lu(n,γ)^{177m}Lu reaction with thermal neutrons is 7 ± 2 barns. The branching ratio of the beta decay of ^{177}Yb to ^{177m}Lu is $3 \pm 1 \times 10^{-4}$. (UK)

25557 NUCLEAR g FACTOR OF THE FIRST EXCITED STATE IN ^{106}Pd AND THE INTERNAL FIELD ON PALLADIUM IN NICKEL. Murray, J.; McMath, T. A.; Cameron, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 45: 1813-19(May 1967).

The nuclear g factor of the first excited state in ^{106}Pd was measured by the method of perturbed angular correlations. The perturbed fields used were the internal fields on palladium in dilute iron and cobalt alloys. By comparing the rotation caused by these alloys with the rotation observed when nickel was the host, a measurement of the internal field on palladium in nickel was obtained. The g factor of the first excited state in ^{106}Pd was determined to be +0.35 ± 0.03. The internal field on palladium in nickel at room temperature was found to be −174 ± 13 kOe. (auth)

25558 DECAY OF ^{245}Am. Bunker, M. E.; Hoffman, D. C.; Orth, C. J.; Starner, J. W. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Nucl. Phys., A97: 593-9 (1967). (LA-DC-8509).

The γ-ray and conversion electron spectra of ^{245}Am (2.08 h) were studied with Ge(Li) and Si(Au) detectors. Three γ transitions were observed, with energies (in keV) and relative intensities (in percent per disintegration) as follows: 240 (1.2), 252.3 (20), and 296 (0.55). Conversion coefficient measurements indicate that the 252.3-keV transition is predominantly M1. It is concluded that the previously reported 0.905-MeV β transition proceeds to the ground state of ^{245}Cm and that its total intensity is 78%, corresponding to a log ft value of 6.3. Two other levels, of energy 252.3 and 296 keV, are populated by direct β transitions, the respective β intensities (and log ft values) being ≈17% (6.4) and ≈5% (6.9). The characteristics of the observed levels are readily interpretable in terms of the Nilsson model. (auth)

25559 INFLUENCE OF THE NUCLEAR QUADRUPOLE MOMENT ON THE ELECTRON RADIAL WAVE FUNCTION. Wold, E. (Oslo Univ.). Nucl. Phys., A97: 620-30(1967).

The influence of the intrinsic nuclear quadrupole moment on the electron radial wave function was calculated for the two cases ^{166}Er and ^{238}Pu using first-order perturbation theory. Assuming an intrinsic quadrupole moment of 5 b for both cases, the ratios between the perturbed radial functions and the corresponding unperturbed ones are generally found to be of the order of 1% for the "field-sensitive" functions and they are practically independent of the electron energy. However, when the unperturbed electron angular momenta are $j = \frac{3}{2}$ and $l = 1, 2$, the ratios became as large as 70% in special cases, and a marked dependence on the electron energy is obtained. (auth)

25560 THE DECAYS OF ^{234}Np AND ^{234m}Pa(UX$_2$). Wapstra, A. H. (Instituut voor Kernphysisch Onderzoek, Amsterdam. Technological Univ., Delft, Netherlands). Nucl. Phys., A97: 641-56(1967).

Using different beta and gamma spectrometers and coincidence equipment, the decay of 4.4-day ^{234}Np was reinvestigated. Thirty-two gamma transitions are placed in a ^{234}U level scheme with 15 levels, 10 of which can be given dependable spin-parity assignments. The decay energy of ^{234}Np, as determined from the percentage K-capture to the two strongly fed levels at about 1590 keV, is 1800 ± 15 keV. New Nilsson model assignments are suggested for these two levels and for ^{234}Np. With Ge(Li) counters, 34 gamma rays are found in the decay of 1.2m ^{234}Pa(UX$_2$), including all but two stronger ^{234}Np γ rays. Seven more ^{234}U levels are proposed to explain the majority of these transitions. (auth)

25561 PARAMETERS OF SLOW NEUTRON RESONANCES IN Sm, Gd, Ta, Re, AND Ir ISOTOPES. Poortmans, F.; Ceulemans, H. (SCK-CEN, Mol, Belg.). Nucl. Phys., A97: 657-65(1967).

Measurements of the ratio Γ_n/Γ by resonant scattering experiments with a neutron crystal spectrometer were performed in order to determine the spin J of the resonances. The following results were obtained: ^{147}Sm, 3.4 eV: J = 3; ^{147}Sm, 18.3 eV: J = 4; ^{149}Sm, 0.0976 eV: J = 4; ^{149}Sm, 0.87 eV: J = 4, ^{151}Gd, 17.1 eV: J = 2; ^{181}Ta, 24.1 eV: J = 3; ^{185}Re, 2.156 eV: J = 3; ^{191}Ir, 0.654 eV: J = 2; ^{191}Ir, 5.36 eV: J = 2; ^{193}Ir, 1.303 eV: J = 2; and probably J = 2 for two resonances at 9.07 eV of ^{191}Ir and ^{193}Ir. (auth)

25562 AN INVESTIGATION OF TWO EXCITED 0^+ STATES IN ^{168}Yb. Kemp, K.; Hagemann, G. B. (Univ. of Copenhagen). Nucl. Phys., A97: 666-72(1967).

An experimental investigation of two 0^+ states in ^{168}Yb with excitation energies of 1197 and 1543 keV was performed. The states were populated by the (p,2n) reaction. The lifetimes were investigated by means of delayed coincidences between the neutrons evaporated from the reaction and the conversion electrons from the decay of the states. For both states the lifetimes were found to be ≤1.5 nsec. Electron γ-coincidence measurements showed no cascades related to the 1197-keV transition. The possibilities for other decays from a rotational band built on the 1197-keV state are considered, but seem unlikely. (auth)

25563 SEMI-MICROSCOPIC DESCRIPTION OF ODD-MASS Tl AND Au SPECTRA. Alaga, G. (Zagreb Univ. Ruder Boskovic Inst., Zagreb); Ianlongo, G. Nucl. Phys., A97: 600-8 (1967).

A qualitative description of the properties of the low-lying states of odd-proton nuclei around lead isotopes is proposed in terms of protons (holes) coupled to a harmonic vibrator. (auth)

25564 FORM FACTOR OF THE β SPECTRUM OF ^{170}Tm ENDING IN THE 2^+ LEVEL OF ^{170}Yb. Greverie, Francois; Ambrosino, Georges (Centre d'Energie Atomique, Gif-sur-Yvette, France). Comp. Rend., Ser. B, 264: 651-4(Feb. 20, 1967). (In French).

The form factor of the 883-keV β group of ^{170}Tm was obtained using a β spectrometer with axial magnetic field. The spectrometer was equipped with a fast $\beta-\gamma$ coincidence circuit. The value found was $C(W) = 1 - 0.59/W$ and its expression analogous to that predicted by theory was $C(W) = 1 - 0.362W + 0.067W^2 - 0.576/W$. (tr-auth)

Nuclear Theory

Refer also to abstracts 25283, 25321, 25399, 25423, 25432, 25484, 25488, 25499, 25535, 25559, and 25563.

25565 (AED-C-34-01) BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK, SEKTION 34: RECHENPROGRAMME IN DER KERNPHYSIK. (Bibliographies in Nuclear Science and Technology. Section 34: Computer Programs in Nuclear Physics). Wittig, S. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Oct. 1966. 188p. (In English and German). Dep. mn.

A bibliography is presented of the articles on computer programs in nuclear physics, mathematics, computers, and reactors appearing up to November 1965. There are an author, report-number and subject indexes cross referenced to the titles. (J.S.R.)

25566 (ISS-67/02) QUASI-FREE SCATTERING EXPERIMENTS AND THE CALCULATION OF SINGLE PARTICLE ENERGIES IN NUCLEI. Amaldi, U. Jr. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Jan. 16, 1967. 38p. (CONF-661050-1). Dep.

From 52nd Congress of the Italian Physical Society, Trieste, Italy.

Quasi-free scattering experiments are discussed from the point of view of the measurement of nuclear separation energies, and the results obtained with (p,2p) and (e,e'p) reactions are summarized. The present theoretical situation of the calculations of these separation energies in finite nuclei is reviewed and the available results are compared with the experimental data. (auth)

25567 (NYO-3525-16) ANALOG RESONANCE MODULATION OF RADIATIVE NUCLEAR REACTIONS. Fallieros, S. (Bartol

Research Foundation, Swarthmore, Pa.). Feb. 1967. Contract AT(30-1)-3525. 14p. (CONF-670203-2). Dep. CFSTI.

From International Conference on Electromagnetic Interactions at Low and Intermediate Energies, Dubna, USSR.

An investigation of the properties of (p,γ) reactions proceeding through an isobaric analog resonance is summarized. The reaction $^{88}Sr(p,\gamma)^{89}Y$ is treated as an example. A description is given of the (p,γ) reaction that takes into account the possibility that the reaction can proceed either through the formation of an analog resonance and its subsequent radiative deexcitation or through the giant dipole resonance that modulates the T-lower background that surrounds the analog state. (D.C.W.)

25568 (RHEL/R-131) A PROGRAMME FOR DWBA CALCULATION OF CHARGE-EXCHANGE REACTIONS AND INELASTIC SCATTERING. Friedman, E. (Rutherford High Energy Lab., Chilton (England)). Oct. 1966. 42p. Dep. mn. HMSO 6s. 0d.

A FORTRAN computer programme for distorted wave Born approximation calculations on direct charge-exchange (p,n) reactions is described. Spin-orbit effects in the distorting potentials are not included in the present version of the program. (auth)

25569 (UR-875-190) SPECTRAL DISTRIBUTIONS IN NUCLEI. French, J. B. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Mar. 8, 1967. Contract AT(30-1)-875. 70p. Dep. CFSTI.

The general properties of nuclear spectra are discussed using the standard mathematical techniques of linear algebra combined with a second quantization formalism. The methods consider low moments of the distributions of the various quantities, rather than the detailed spectra. The techniques can be used to describe group symmetries in nuclei and the distributions of the strengths for various kinds of processes. (S.F.L.)

25570 (USNRDL-TR-1101) BETA SPECTRA. V. SPECTRA OF INDIVIDUAL POSITRON EMITTERS. Hogan, O. L. (Naval Radiological Defense Lab., San Francisco, Calif.). Nov. 14, 1966. 134p.

Spectra for 219 positron emitters were computed, with energy intervals of 0.01 MeV (^{92}Nb and ^{177}Ta at shorter intervals). The computation was based on the Fermi theory of beta decay, with a correction factor for unique-forbidden transitions. These energy spectra, after normalization and plotting, are presented, along with the data used in their computation. (auth)

25571 THE GREEN'S FUNCTION METHOD IN THE THEORY OF STRIPPING. Kadmenskii, S. G. (Voronezh State Univ., USSR). Yadern. Fiz., 5: 759-65(Apr. 1967). (In Russian).

The Green's function method was used to derive an accurate expression for the stripping amplitude in terms of mass operators and many-point graphs corresponding to the effective interaction amongst nucleons inside the nucleus. The stripping reactions are classified according to the type of the final nucleus excitation. The exchange terms in the amplitude are analyzed and are connected with Feynman graphs. The supplementary conditions for the calculation of (d,p) reaction cross sections are indicated. The formulas obtained are generalized for the reactions of the type $A(A_1, A_1 - 1)A + 1$, where $A_1 \gg A$. (auth)

25572 LEVELS OF MEAN NUCLEAR FIELDS. Kalinkin, B. N.; Grabovskii, Ya.; Gareev, F. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., 30: 999-1013(Dec. 1966). (In Russian).

The variation of the approximate solution of the Schroedinger equation with the Saxon-Bud potential was shown. The wave functions of single-particle states were obtained in analytical form as well as some integrals from their combinations. The results can be used in different applications of the theory of nuclei and nuclear reactions. (tr-auth)

25573 CALCULATION OF INTERNAL CONVERSION COEFFICIENTS WITH SCREENING OF NUCLEAR FIELD TAKEN INTO ACCOUNT. Anderson, E. M.; Anderson, E. K.; Trusov, V. F. Yadern. Fiz., 5: 741-5(Apr. 1967). (In Russian).

A method for calculation of internal conversion coefficients is given that is applicable to calculations concerning high atomic subshells. The method is based on the numerical solving of the Dirac equation with corresponding effective potentials. A further advance consists in the application of a semiempirical method that makes one able to get the coincidence between the theoretical energies and the experimental values. The finite size of a nucleus is taken into account. The results are compared with the experimental data and with the calculations performed using other methods. (auth)

25574 NILSSON'S MODEL WITH AN ACCOUNT OF THE ROTATIONS; SHELL N = 4. Pogosyan, V. S.; Sardaryan, R. A. Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 1: 289-309(1966). (In Russian).

The axial-symmetric model of the odd-A nucleus, consisting of a rotating core and an external nucleon moving in the field of core is investigated. Nilsson's potential is chosen as the field in which the external nucleon moves. The nucleon remains stiff with respect to the γ-vibrations. The single-particle states of the shell N = 4 are found. The theoretical calculation is in full agreement with the experimentally excited states of the nuclei ^{153}Eu, ^{189}Ir, ^{191}Ir, ^{193}Ir, ^{167}Tm, ^{169}Tm, and ^{171}Tm. (auth)

25575 TWO-PION-EXCHANGE POTENTIAL WITH NUCLEON-PAIR EFFECTS. Hiroshige, Noboru (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 37: 75-87(Jan. 1967).

Two-pion-exchange potentials with nucleon-pair effects are calculated by taking full recoil into account. It is shown that a strong LS potential of the order of magnitude indicated by experiments can be obtained if consideration is made of nucleon pairs in the intermediate state. (auth)

25576 CHARGE DISTRIBUTION IN NUCLEI. Hwang, Jenn-lin (National Taiwan Univ., Taipei, Taiwan). Chin. J. Phys. (Taiwan), 4: 55-9(Oct. 1966).

Assuming that the proton has a charge distribution of the type determined by Hofstadter, the charge distribution of a nucleus is composed in accordance with a scheme suggested from the newly found systematics of nuclear radii. A simple superposition of the charge distribution of protons is, however, unable to give a correct rms radius for a nuclear charge distribution. Therefore the parameters included in the proton charge distribution are adjusted to match the correct rms radius. This is supposed from the fact that the charge distribution of a single proton is different from that of a proton within the nucleus. (auth)

25577 STATISTICAL MECHANICS OF A SUPERFLUID NUCLEAR MATTER. II. NUCLEAR LEVEL DENSITY. Canuto, V. (CIEA, Mexico City); Fassio, L.; Rojo, O. Nucl. Phys., A97: 223-31(1967).

The Bogolyubov-Valatin canonical transformation used in the problem of the residual interactions does not diagonalize completely the nuclear Hamiltonian. An interaction among quasi-particles still remains. Its influence on the nuclear entropy is studied using a thermodynamic perturbation treatment. It is shown that this interaction increases by ΔS the nuclear entropy with respect to the one of the independent quasi-particles, and that the quantity ΔS for nuclei differing in the way their shells are filled (^{48}Ca, ^{52}Cr, and ^{58}Fe) ranges between 0.6 to 1.2 for excitation energies of about 10 MeV. (auth)

25578 ABSOLUTE CROSS SECTIONS FOR TRITON- AND ^{3}He-INDUCED REACTIONS. Rook, J. R. (Univ. of California, Berkeley. Oxford Univ.). Contract W-7405-eng-48. Nucl. Phys., A97: 217-22(1967). (UCRL-17119).

The Ohmura wave function for the three-body system is used to obtain estimates of the absolute cross sections for (t,d) and (^{3}He,d) reactions. Qualitative agreement with the experimental data is obtained, but it is found that the results are too sensitive to the parameters of the calculation for any quantitative conclusions to be drawn. The same three-body wave function is used to investigate the relative amplitudes for singlet and triplet spin transitions in (^{3}He,p) reactions. These transitions are calculated to be about equally probable but a precise comparison with experiment is difficult as it is necessary to make detailed assumptions concerning the wave functions of the nuclei concerned. A rough estimate gives satisfactory agreement with experiment. (auth)

25579 RESIDUAL INTERACTION IN NUCLEI. Bochnacki, Z. (Inst. of Nuclear Physics, Krakow); Holban, I. M.; Mikhailov, I. N. Nucl. Phys., A97: 33-51(1967).

The residual interaction in nuclei is introduced through the self-consistency conditions for the single-particle potential of the generalization Hartree-Fock method. The general features of the interaction are discussed, and its explicit form is derived for some realistic models giving the single-particle potential in finite nuclei. (auth)

25580 INTERMEDIATE COUPLING IN THE NUCLEAR ds-SHELL. Bouten, M. C.; Elliott, J. P.; Pullen, J. A. (Univ. of Sussex, Brighton, Eng.). Nucl. Phys., A97: 113-43(1967).

Energy-level diagrams are calculated for almost all nuclei in the mass region $18 < A < 38$ using an intermediate coupling approach. An interpolation method is used to pass between the U_3 scheme in LS coupling and the jj coupling extreme. The results are compared with the known energy levels. (auth)

25581 VARIATIONAL APPROACH TO TWO-BODY CORRELATIONS IN FINITE NUCLEI. Brink, D. M.; Grypeos, M. E. (Oxford Univ.). Nucl. Phys., A97: 81-105(1967).

A variational approach to finite nuclei in their ground state is developed using two-body interactions containing cores. The formalism involves the use of shell-model wave functions with an effective nuclear Hamiltonian, which is obtained from the original

Hamiltonian by a unitary transformation. Only the one- and two-body terms of its cluster expansion are considered. Correlations should be of short range so that the cluster expansion converges rapidly, and therefore suitable restrictions are introduced when applying the variational principle. Two types of restrictions are considered: there should be no correlations beyond a separation distance d; and a suitable integral constraint is imposed on the two-body wave function, so that it may heal rapidly. The formalism in this second case is extended to allow for non-central forces. Numerical results are given for the matrix elements of a pair of nucleons in ^{16}O using the Kallio-Kolltveit potential. (auth)

25582 SYMMETRIZATION OF THE ENTRANCE AND EXIT CHANNELS IN THE THEORY OF COMPLEX COLLISIONS. Guyaux, J.; Pigeon, J.; Barguil, J.; Lafoucriere, J.; El-Baz, E. (Univ., Lyon). Nucl. Phys., A97: 193-202(1967). (In French).

It is shown that the choice of a common basis for entrance and exit channels eliminates the post-prior discrepancy which appears when the Born approximation is applied to transition matrix elements of rearrangement collisions. The solution of the three-body Schrödinger equation gives the eigenvectors of that common basis in (d,p) reactions. The transition matrix element is then obtained by integrating the product of Fourier transformed initial states, final states, and the potentials. The integration is performed over a Fourier space bearing a special metric. (auth)

25583 DESCRIPTION OF FERMION SYSTEMS IN BOSON REPRESENTATIONS. Soerensen, Bent (NORDITA, Copenhagen). Nucl. Phys., A97: 1-32(1967).

The application of boson techniques in the study of systems with an even number of fermions is examined. Different methods are tested in the degenerate model. For use in realistic cases, in which several subshells play a role, an approximation based on the isolation in the boson space of collective branches of excitations is suggested. This method is applied to pairing vibrations in Pb with a satisfactory result. (auth)

25584 CORRELATION FUNCTION AND π^- MESON ABSORPTION. Nguyen-Trung, C.; Sakamoto, Y. (Kyoto Univ.). Nucl. Phys., B1: 139-57(1967).

The absorption of π^-'s is considered to occur on a strongly correlated nucleon pair whose wave functions are constructed from harmonic oscillator ones and contain a correlation function $f(r) = 1 - \exp(-\beta r^2)$. The absorption rates of π mesons as a function of the momenta of the nucleons within the nucleus are calculated to obtain the momentum distributions of the nucleons. It is shown that, without the correlation function ($\beta \to \infty$), the absorption rates are too small, and its inclusion is obviously necessary to reproduce the experimental data. Furthermore, the absorption rates and momentum distributions are strongly affected by the value of β the determination of which can thus be obtained by comparing theoretical results with experimental data. (auth)

25585 COULOMB EXCITATION VIA THE GIANT DIPOLE RESONANCE IN SPHERICAL NUCLEI. Douglas, A. C. (Atomic Weapons Research Establishment, Aldermaston, Eng.); McDonald, N. Phys. Lett., 24B: 447-9(May 1, 1967).

Using the dynamic collective model for spherical nuclei, it is found that E1-E1 Coulomb excitation by way of the giant dipole resonance is an order of magnitude smaller than the reorientation effect. (auth)

25586 PARA- AND ORTHOSTATES IN ATOMIC NUCLEI. Birbrair, B. L.; Sliv, L. A. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Lett., 24B: 444-6(May 1, 1967).

Particle-hole states are classified according to the type of external field which can excite them. In this way, particle-hole states can be characterized approximately by the values 0 or 1 of their intrinsic spin. (auth)

25587 POSSIBILITY OF IMPROVING THE ACCURACY OF TIME-REVERSAL INVARIANCE TESTS. Kajfosz, J. (Nuclear Research Inst., Prague). Phys. Lett., 24B: 443-4(May 1, 1967).

Optimum values of the effect on T-noninvariance of nuclear forces on photon angular correlation functions show that a considerable progress in the accuracy of time reversal invariance tests is possible. It is conditioned on the employment of more suitable experimental objects, the properties of which are discussed. (auth)

25588 EFFECT ON β-DECAY PROBABILITY OF VARIATIONS OF THE LIGHT PARTICLE WAVE FUNCTIONS WITHIN THE NUCLEUS. Dudnikova, T. A.; Mikhailov, V. M. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 185-9(Jan. 1966). (In Russian).

It is shown that the approximation usually employed in beta decay calculations (i.e., evaluation of the lepton wave functions at the nuclear boundary) gives rather accurate results both for the shape of the spectrum (the deviations are of the order of tenths of a percent over a 1 mc^2 range) and for the total beta decay probability. The corrections to the total decay probability and to the shape of the spectrum for allowed and unique beta transitions are evaluated with the aid of nuclear wave functions based on nuclear models. (J.F.P.)

25589 INTRODUCTION OF COLLECTIVE VARIABLES TO DESCRIBE NUCLEAR MOTION. Belyak, V. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 175-84(Jan. 1966). (In Russian).

For the description of nuclear motion, collective coordinates and their corresponding collective momenta which are symmetric functions (with respect to the particles) of the initial coordinates are introduced. Nuclear systems are described without explicitly using the internal variables, and without specifying them as functions of the initial variables. Only the collective coordinates and collective momenta will be defined in terms of the initial variables. The further formalism of the theory will be so constructed that the dependence of all physical quantities on the collective variables will always occur only in combinations that are defined in terms of the initial variables. (J.F.P.)

25590 ALPHA-PARTICLE CLUSTERING IN LIGHT NUCLEI. Kadmenskii, S. G. (Voronezh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 138-43(Jan. 1966). (In Russian).

A Green function technique is used to develop a superfluid model of alpha particle clustering which would explain the structure of two-, three-, and four-particle clusters and at the same time account for the energy gap in the single-particle excitation spectra of the light nuclei. An even-even nucleus with $N = Z = 2n$ is considered. This proposed model allows the formation of two- and three-particle Cooper-type clusters, which are fully analogous to the alpha-particle clusters but have lower binding energies (smaller vertex parts). Clusters of five or more particles are not possible according to this model because the presence of so many particles in states of the same energy is forbidden by the Pauli principle. (J.F.P.)

25591 MULTIPOLE EXPANSION OF A TWO-BODY INTERACTION IN HELICITY FORMALISM AND ITS APPLICATIONS TO NUCLEAR STRUCTURE AND NUCLEAR REACTION CALCULATIONS. Raynal, J. (CEN, Saclay, Gif-sur-Yvette, France). Nucl. Phys., A97: 572-92(1967).

For a multipole expansion in a helicity formalism, the calculation of matrix elements of a two-body interaction involves a geometry quite independent of the spins. The total angular momentum quantum numbers j are used instead of the orbital ones; the number of different form factors increases with the value of the spin but a useful factorization can be obtained in the calculations. (auth)

25592 OPTICAL MODEL POTENTIAL FOR DEUTERONS. Perey, F. G.; Satchler, G. R. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A97: 515-28(1967).

The elastic scattering of deuterons from nuclei is compared with the predictions of an optical-model potential whose real part is obtained by averaging a neutron and proton optical potential over the internal motion of the deuteron. Good agreement is obtained if the depth of the potential is changed by 10 to 20%. The optimum imaginary potentials extend to much larger radii than are predicted by this model. The significance of the results is discussed in some detail. (auth)

25593 HIGH-RESOLUTION TRANSVERSE SUM RULES FOR ELECTRONS SCATTERED INELASTICALLY FROM LIGHT NUCLEI. Czyz, W.; Lesniak, L.; Malecki, A. (Inst. of Nuclear Physics, Krakow). Ann. Phys. (N. Y.), 42: 97-118(Mar. 1967).

A series of sum rules is proposed for inelastic electron scattering at $\theta = 180°$, each containing contributions from transitions of a given multipolarity. This approach is applied to study the form factors of the giant dipole resonance, and the results are compared with the existing experimental data and the results of calculations based on the microscopic theory of the dipole vibrations in nuclei. (auth)

25594 TRANSVERSE SUM RULE FOR ELECTRONS SCATTERED INELASTICALLY WITH LARGE MOMENTUM TRANSFERS FROM LIGHT NUCLEI. Czyz, W.; Lesniak, L.; Malecki, A. (Inst. of Nuclear Physics, Krakow). Ann. Phys. (N. Y.), 42: 119-43(Mar. 1967).

A sum rule for the cross sections of electrons inelastically scattered from nuclei is analyzed. This sum rule contains contributions only from the transverse electron-nucleus interactions and is particularly suitable for analyzing the experiments of inelastic electron scattering at $\theta = 180°$. The sum rule is a function of the three-momentum transfer q. A discussion of this sum rule for momentum transfers $0.5f^{-1} \lesssim q \lesssim 2f^{-1}$ is presented. Strong dominance of the spin-current contribution seems to offer a very attractive possibility of measuring magnetic moments of nucleons bound in nuclei. Estimates of the short-range nucleon-nucleon correlation contributions to the sum rule are included. (auth)

25595 PROTON–NUCLEI SCATTERING AT 27 GeV/c. Bernheim, A. (Faculte des Sciences, Paris); Fayolle, J. C.; Van Hollebeke, M.; Morand, M.; Faucher, G. J. Phys. (Paris), 28: 139-41(Feb. 1967). (In French).

In order to eliminate the scanner's bias, the well-known $P(\alpha) = G(\alpha) + S(\alpha)$ probability distribution for small deflections of a particle in nuclear emulsion is used to select events outside the Gaussian limit of multiple scattering. This, having been tested in a preceding work (3-GeV/c antiprotons), is now applied to elastic interactions of 27-GeV/c protons with nuclei. The experimental results obtained between 1 and 3 mrd agree with the optical-model calculations using $R_0 = 1.40$ fermi, W = 22 MeV, and $V_0 = 10$ MeV. (auth)

25596 DYNAMIC NUCLEAR POLARIZATION BY CYCLES OF THERMAL MIXING. Goldman, M. (Centre d'Etudes Nucleaires, Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), 28: 211-15(Feb. 1967). (In French).

A method is described of dynamic nuclear polarization by means of cycles of thermal mixing in three steps: cooling of an intermediate system, thermal mixing in zero field with the spins to be polarized, and adiabatic magnetization. This method puts in action in separate steps phenomena which are totally or partially intermingled in the methods of polarization by solid effect or by thermal mixing in zero field. Experiments did produce a polarization of the protons of paradichlorobenzene by this method to a value however smaller for practical reasons, than the maximum predicted by the theory. (auth)

25597 FUNDAMENTALS OF NUCLEAR PHYSICS. Arya, Atam P. Boston, Allyn and Bacon, Inc., 1966. 656p.

A balanced presentation with equal emphasis on theory and applications is given. Nuclear forces, models, reactions, and size are treated separately, and a section on detectors is included. Relativistic mechanics and wave mechanics are reviewed. (D.C.W.)

25598 ISOBARIC SPIN IN NUCLEAR PHYSICS. Proceedings of the Conference, Tallahassee, Florida, March 17–19, 1966. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966. 908p. (CONF-660306).

The most recent experimental and theoretical developments in the study of the role of isobaric spin in nuclear reactions and nuclear structure are presented. Separate abstracts were prepared for 36 of the 63 papers presented. Others have previously appeared in NSA. (S.F.L.)

For abstracts of individual papers see: 25434–25440, 25467–25473, 25519–25530, and 25599–25608.

25599 ISOBARIC SPIN AND ANALOGUE SPIN. MacDonald, William M. (Univ. of Maryland, College Park). pp 173-93 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

An investigation is made of the effects of Coulomb forces on the nuclear properties based on isobaric spin. It is found that the distortions which are introduced can be included in a wave function which possesses a more general symmetry than that of the usual isobaric spin states. These wave functions are obtained from a generalization of isobaric spin into "analog" spin. The significance of the name is that the corresponding states recently discovered in heavy nuclei which are called analog states are actually eigenfunctions of the analog spin quantum number. Calculations with analog spin are more difficult than with isobaric spin because of the lack of commutativity between spin and scalar functions. However, the simplicity of calculations with isobaric spin is gained at the expense of using unrealistic wave functions, particularly in the asymptotic region and for continuum states. (S.F.L.)

25600 ISOBARIC-SPIN PURITY IN THE GIANT RESONANCE. Segel, R. E. (Argonne National Lab., Ill.). pp 194-218 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The giant resonance has been described in terms of neutron and proton excitations in the shell model and in terms of isobaric spin. An investigation is made to determine which of these descriptions best represents the states of the giant resonance. Since isobaric spin is expected to be, to some approximation, a good quantum number, the approach is to describe the giant resonance in terms of pure isobaric spin states and then to determine how much modification is required to fit the experimental data. It is found that the giant resonance can, to a first approximation, be described as one or two states with well-defined isobaric spin. Most of the data is for nuclei up to about ^{40}Ca and in this region there is very definite evidence that isobaric spin impurities are present. The ratio of proton-to-neutron emission indicates the presence of an isobaric-spin impurity in the giant resonance of the self-conjugate nuclei that rises with atomic number and reaches a value of about 15% at ^{40}Ca, the highest stable self-conjugate nucleus. (S.F.L.)

25601 ISOBARIC SPIN AND PARTICLE-HOLE EXCITATIONS. Zamick, Larry (Princeton Univ., N. J.). pp 301-6 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

Nuclear excited states with configurations of n holes and m + n particles are examined theoretically. Basic states of the system are considered in which the particles have a definite isobaric spin T_p, the holes a definite isobaric spin T_H, and the total system has an isobaric spin T. Conditions are examined for which the quantum numbers T_p and T_H are fairly good quantum numbers, i.e., conditions for which the basis states $[T_p, T_H]T$ are fairly good approximations to the eigenstates of the system. (S.F.L.)

25602 REMARKS BY H. MORINAGA. Morinaga, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 352-6 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A qualitative explanation is given for the asymmetry of the resonance in (p,n) cross sections. (S.F.L.)

25603 ISOBARIC-SPIN SPLITTING OF NUCLEAR EXCITATIONS. Macfarlane, Malcolm H. (Argonne National Lab., Ill.). pp 383-410 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

In nuclei which are not self-conjugate, nuclear excitations which carry nonzero isobaric spin can produce final states with several possible valves of isobaric spin T. Since nuclear forces are isobaric-spin dependent, the various T-fragments of the excitation under consideration may be widely separated in energy. This T-splitting of nuclear excitations is discussed using shell-model wave functions. (S.F.L.)

25604 RESONANCE REACTIONS AND ISOBARIC SPIN PURITY. Robson, D. (Florida State Univ., Tallahassee). pp 411-36 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The conventional description of isobaric spin mixing involving bound shell model states leads into difficulties when the states involved are in the continuum. A brief review is given of the approaches that have been tried in discussing isobaric spin mixing in the continuum. These include R-matrix, channel-coupling, and shell-model resonance theory. The comprehensive nuclear reaction formalism introduced by Lane and Robson is used to outline how a rigorous theory of isobaric analog resonances can be developed. (S.F.L.)

25605 REMARKS BY E. P. WIGNER. Wigner, E. P. (Princeton Univ., N. J.). pp 437-46 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A discussion is given on the nature of the isobaric spin resonances when these occur at an energy at which the density of the "normal" levels, i.e., the levels with $T = T_Z$, is high. Under this condition, the state, the isobaric spin of which would be $T = T_Z + 1$ if the interaction between all pairs of nucleons were strictly equal, dissolves under the influence of the Coulomb forces into a giant resonance. This means that the wave function with $T = T_Z + 1$ is not the wave function of a single resonance but appears as an admixture to the wave function of several resonances, i.e., those which are close on the energy scale to the place where the $T = T_Z + 1$ resonance would be in the absence of Coulomb forces and other violations of the strict equality of the proton-proton, proton-neutron, and neutron-neutron interactions. The properties of the levels which possess an admixture from the $T = T_Z + 1$ state are different from the properties of the states which have no such admixture or only a very small one. It is proposed that these levels form the giant resonance. (S.F.L.)

25606 ISOBARIC SPIN AND THE OPTICAL MODEL. Soper, J. M. (Atomic Energy Research Establishment, Harwell, Eng.). pp 565-75 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A brief review is given of the evidence supporting the isobaric spin term in the real part of the optical-model potential used to describe scattering of nucleons by nuclei. (S.F.L.)

25607 CONTRIBUTION OF SECOND FORBIDDEN MATRIX ELEMENTS TO ISOBARIC SPIN FORBIDDEN BETA-TRANSITIONS: ^{66}Ga. Van Neste, L.; Coussement, R.; Deutsch, J. P. (Univ. of Louvain, Belg.). pp 677-88 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

A non-statistical spectrum shape factor is obtained for the $(0^+) \rightarrow (0^+)$ ground-state transition from ^{66}Ga to ^{66}Zn. This transition is investigated both experimentally and theoretically by measuring the shape-factor with a short-lens magnetic spectrometer and using a χ^2 analysis of the data. (S.F.L.)

25608 ANALYSIS OF ISOBARIC ANALOGUE RESONANCES AS BREIT-WIGNER TYPE RESONANCES. Jones, G. A. (Atomic Energy Research Establishment, Harwell, Eng.). pp 857-62 of Isobaric Spin in Nuclear Physics. Fox, John D.; Robson, Donald (eds.). New York, Academic Press, 1966.

The excitation functions arising from proton bombardment of medium and heavy nuclei in the energy range $E_p \sim 4$ to 10 MeV have the appearance of typical Breit–Wigner resonances superimposed on a continuous background. Careful measurements may reveal asymmetry in the shapes of the resonances, but the measurements are generally not sufficiently precise, and analysis is usually made by subtracting out the background and applying the Breit–Wigner formula. An approach to the reaction mechanism due to Lane [Phys. Letts. 11: 329(1964)] gives a Breit–Wigner shape to the resonance, but a more thorough approach by Robson [Phys. Rev. 137: B535(1965)] gives an expression for the cross section, under approximations which may not hold, which has a built-in asymmetry and does not appear to be a function of the same parameters which describe the Breit–Wigner type resonance. These two methods are compared in the case of a reaction, when Robson's conditions are likely to hold, having a resonance shape sufficiently near symmetrical to justify a Breit–Wigner fit. (S.F.L.)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 24114, 24139, 24141, 24143, 24144, 24155, 24735, 24855, 25565, 25695, and 25723.

25609 (AAEC/E-161) PERTURBATION THEORY APPROACH TO FUEL MANAGEMENT STUDY OF THE PEBBLE BED REACTOR. Bicevskis, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sept. 1966. 16p. Dep.

A method based on perturbation theory is given to assess the relative merits of fuel management schemes for the pebble bed reactor. The method is suitable for multigroup treatment and can be applied to other continuously fuelled reactors. As a specific example the computer code N.I.B. is developed based on spectrum weighted one-group treatment. Preliminary reactivity lifetime investigations are described. Some power density calculations are also reported for a random distribution of the pebbles. (auth)

25610 (AAEC/TM-339) EXPERIMENTAL ASSESSMENT OF A PEBBLE REFLECTOR AND PEBBLE FLOW IN A SMALL SCALE RECIRCULATING PEBBLE BED. Rogers, L. R. Scott (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug. 1966. 28p. Dep.

The erosion behavior of a pebble reflector was examined using small scale, three-dimensional, pebble-bed models and the split-bed technique. An exponential-type change in the reflector-fuel interface angle was indicated. Data on downflow and upflow air tests with small-scale, recirculating pebble beds are also presented. These data indicated a variation in pebble discharge ratio of some 20% relative to the no-airflow case. (auth)

25611 (AAEC/TM-344) THERMAL AND STRESS PERFORMANCE OF A PEBBLE BED REACTOR. Hawker, P. A. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sept. 1966. 19p. Dep.

A method for determining the thermal and stress performance of a pebble bed reactor is described. Some results based on this analysis are presented to indicate the likely trends. (auth)

25612 (AAEC/TM-350) A BURNUP SURVEY OF Pu-Th-BeO FUELS AND COMMENTS ON SELECTION OF FUEL FOR PEBBLE BED REACTORS. Bicevskis, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov. 1966. 21p. Dep.

The results of a burnup survey for a BeO pebble bed reactor system are reported. The survey was based on an equilibrium model and carried out by means of the GYMEA complex of codes. A once-through fuel cycle was assumed with Pu and Th as the fissile and fertile materials. The selection of a fuel composition is discussed, taking into consideration reactivity lifetime, initial power density, and temperature coefficients of reactivity. With a 200 MWe pebble bed reactor design, values of fissions per initial fissile atom of 1.2 to 1.4 appear to be achievable at an average bulk power density of 11 W/cm^3. (auth)

25613 (ACNP-6103) PATHFINDER ATOMIC POWER PLANT. IRRADIATION TEST FOR THE PATHFINDER HIGH ENRICHMENT SUPERHEATER FUEL ELEMENT. EVALUATION OF TEST FACILITIES. (Allis-Chalmers Mfg. Co., Milwaukee, Wis. Atomic Energy Div.). Jan. 6, 1961. Contract AT(11-1)-589. 34p. Dep. CFSTI.

For Northern States Power Co., Minneapolis, Minn. and Central Utilities Atomic Power Associates.

A feasibility study of irradiating a high enrichment superheater element in SADE, EBWR, or BORAX V is given. The Pathfinder Atomic Power Plant is the first reactor to incorporate an integral nuclear superheater. A general description of this superheater is given. Test facilities proposed for use are described and compared. (M.L.S.)

25614 (ACNP-67517) PATHFINDER ATOMIC POWER PLANT. TWO-PHASE LEVEL MEASUREMENTS (TEST 161); STEAM DRYER EFFICIENCY MEASUREMENTS (TEST 162). Kintner, L. L.; Raby, T. M.; Kelly, J. P.; Larson, A. M. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). Apr. 1967. Contract AT(11-1)-589. 40p. Dep. CFSTI.

For Northern States Power Co., Minneapolis, Minn. and Central Utilities Atomic Power Associates.

The measurements were made to correlate true water levels in the reactor with indicated water levels at various power production levels to validate design predictions. Establishment of an upper level limit related to superheater moisture and a lower level limit related to water circulation after scram were also investigated. Tests were conducted at power levels up to 85% of the 100 MW(t) design objective. (J.R.D.)

25615 (AHSB(S)-R-105) GEM CODE. Hemmings, P. J. (United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch). 1967. 217p. Dep. mn. CFSTI $3.00 cy, $0.65 mn, HMSO 30s. 0d.

The computer program GEM, which is designed to calculate the reactivity of systems of any geometry by direct simulation of neutron tracks using the Monte Carlo method, is described. The program is written in Fortran II for the IBM 7090 and IBM 7094. (D.C.W.)

25616 (BMwF-FBK-67-06) LISTE DER TR4-PROGRAMME DES INSTITUTS FUER KERNENERGETIK DER TECHNISCHEN HOCHSCHULE STUTTGART. (List of the TR4 Codes of the Institut fuer Kernenergetik der Technischen Hochschule Stuttgart). Siegert, H. J.; Kunert, K. (Technische Hochschule, Stuttgart (West Germany). Institut fuer Kernenergetik). Jan. 1967. 132p. (In German). Dep.

A list of 117 programs for the TR4 computer is given concerning subjects in the field of reactor physics. The referred programming language is Algol 60. For each program an abstract is available. (auth)

25617 (BNWL-SA-374) EFFECTS OF NEUTRON IRRADIATION ON THE ELEVATED TEMPERATURE MECHANICAL PROPERTIES OF NICKEL-BASE AND REFRACTORY METAL ALLOYS. Claudson, T. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 28, 1966. Contract AT-(45-1)-1830. 51p. (CONF-660607-9). Dep. CFSTI.

From 3rd International Symposium on the Effects of Irradiation on Structural Metals, Atlantic City.

Power reactors designed to operate at temperatures and coolant environments dictate the use of Ni-base and refractory metal alloys for structural components, fuel cladding, and power equipment. Investigation of the effects of irradiation and environment upon the mechanical properties of several Ni-base and refractory metal alloys has been initiated. (auth)

25618 (BNWL-SA-821) REMOVAL OF METHYL IODIDE FROM SIMULATED REACTOR CONTAINMENT ATMOSPHERES WITH HYDRAZINE. Mishima, J.; Schwendiman, L. C.; Burger, L. L.; Hasty, R. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 22, 1966. Contract AT(45-1)-1830. 20p. (CONF-660904-14). DTIE.

From 9th Air Cleaning Conference, Boston, Mass.

The reaction of hydrazine and methyl iodide is under study to determine the feasibility of using hydrazine in reactor spray systems to remove organic and molecular forms of radioactive iodine. Rate studies showed that the static removal of methyl iodide from the vapor phase over a 50% hydrazine solution proceeds with a half-life of about six minutes at 50°C. Reaction rate and/or rate of transfer to the solution varies with airborne methyl iodide concentration, liquid hydrazine concentration and the available liquid surface area. Spraying 35% hydrazine solutions through air containing methyl iodide at room temperature and at 75°C effectively scavenges methyl iodide even in the presence of 50 mg/m^3 of molecular iodine. (auth)

25619 (BNWL-SA-978) THE CONCEPTUAL EVALUATION OF A FAST FLUX TEST FACILITY. Astley, E. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1967. Contract AT(45-1)-1830. 54p. (CONF-670413-1). Dep. CFSTI.

From National Topical Meeting on Fast Reactors, San Francisco, Calif.

An evaluation of the concept of the Fast Flux Test Facility is given. The final design is presented in detail. Each major point is discussed. (M.L.S.)

25620 (CEA-R-2990) ELIMINATION DE L'ALUMINE EN SUSPENSION DANS L'EAU LOURDE DES REACTEURS NUCLEAIRES PAR VOIE CHIMIQUE. (Chemical Elimination of Alumina in Suspension in Heavy Water of Nuclear Reactors). Ledoux, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb. 1967. 90p. (In French). Dep.

Thesis.

Corrosion of Al in contact with the moderating water in nuclear reactors leads to the formation of an Al_2O_3 hydrosol which can have an adverse effect on the operation of the reactor. Several physical methods have been used in an attempt to counteract this effect. A method is proposed consisting of the elimination of the Al by dissolution and subsequent fixation in the ionic form on

mixed-bed ion-exchange resins. The parameters and the values of those parameters most favorable to the dissolution process have been determined. If the moderator is heavy water, the deuterated acid can be prepared by converting a solution in heavy water to a salt of the acid using a deuterated cationic resin. (auth)

25621 (CONF-670501-3) DESIGN OF A HIGH-PERFORMANCE UO_2 PULSE REACTOR. Kazi, A. Halim; Tomonto, James R.; Teer, Bill R. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Feb. 1, 1967. Contract AT(30-1)-3501. 34p. Dep. CFSTI.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

The results of a water-moderated pulsed reactor design study based on a high-performance UO_2 fuel element are given. The reactor is designed to provide routinely a fast (>10 keV) fluence of 1.0×10^{15} neutrons $|cm^2|$ pulse in a 9 in. O. D. and 12–16 in. high air-filled irradiation facility. The reactor is cooled by forced convection. The fuel rod fill-gas is argon, each fuel rod being compartmentalized into six axial segments. Pulse behavior of the core is based on the Doppler reactivity shutdown effect in low-enrichment UO_2 fuel rods. (M.L.S.)

25622 (DANATOM-01-67) TRYKBEHOLDERE TIL EUROPAEISKE VANDREAKTORER. (Pressure Vessels for European Water Reactors). (Danish Association for Industrial Development of Atomic Energy, Hellerup). Feb. 1967. 70p. (In Danish). Dep.

A referenced compilation of facts is presented concerning steel pressure vessels as built or designed so far for European light and heavy water reactors. Subjects covered are: design and construction; materials; manufacturing procedures and control; transportation and erection; and prices. Data and specifications are included, and European manufacturers are listed. (Denm)

25623 (EUR-3078.f) ESTIMATION TECHNIQUE DU RISQUE ATOMIQUE EN VUE DE L'ASSURANCE. RAPPORTS PRESENTES A LA REUNION DU GROUPE DE TRAVAIL TENUE LES 2 ET 3 JUIN 1966 A BRUXELLES. (Technical Estimate of the Nuclear Hazard for Insurance Purposes. Reports Submitted at the Working Group Meeting Held in Brussels on June 2 and 3, 1966). (European Atomic Energy Community). Mar. 1967. 106p. (In French). Dep.

A compilation is presented of technical data provided by the nuclear insurers, the nuclear industry suppliers (represented by the Union of Industries of the European Community [UNICE]), the operators of nuclear installations (represented by the Committee for the European Community of the International Union of Producers and Distributors of Electrical Energy [UNIPEDE]), the various national bodies responsible for technical supervision and, the Commission itself. The data are essential for rational determination of insurance premiums in the nuclear field. (auth)

25624 (GA-7595) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending October 31, 1966. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Feb. 2, 1967. Contract AT(04-3)-314. 38p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Reduction of data from reactivity worth measurements, rod scram tests, and reactor noise measurements was completed during the period. Efforts applied to preparations for measurements to be made during approach to power and at power are described. Test procedures for reactor shielding experiments were completed. (J.R.D.)

25625 (GEAP-5427) REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY. Quarterly Progress Report No. 7, October–December 1966. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Feb. 1967. Contract AT(04-3)-189. 51p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The analysis of low-cycle fatigue as a failure mechanism was continued. A pattern for combining the uncertainty distributions by cause for each parameter (stress for example) into one distribution was studied, and a parametric study was conducted of the newly developed equation which enables calculation of the number of cycles of loading for crack growth through a pipe wall. Development of the PAPA (plate and panel analysis) program for stress and strain in pipes is nearly complete. All portions of the computer program have been written and are in advanced stages of checkout. Examples are given of the application of PAPA to specific cases to demonstrate the excellent agreement when compared with results obtained by classical solution methods. Cases analyzed include curved trapezoidal elements (in a shallow cone) as well as flat elements. Problem solutions effort was concentrated on the analysis of stresses caused by earthquakes and on defining piping component preprocessors as required for PAPA code utilization. Completed or in process are preprocessors for the elbow, reinforced 90-degree tee, and branch intersection (variable angle). Fracture toughness testing of small specimens is continuing with the preparation of Manjoine (WOL) specimens of $2\frac{1}{4}$ Cr–1 Mo steel. Burst testing of A-106B pipe was initiated with hydraulic pressurization to failure of an unflawed length of 6-inch Schedule 80 material. In future tests the specimens will have flaws of various shapes and lengths. The initial determination of the effect of cycling rate on fatigue crack growth in A-212B steel at 600°F revealed that slower cycling (0.6 compared to 12 cycles r/min) resulted in appreciably slower crack growth. This possibly is due to the effect of increased strength and a lesser effect by ductility loss–both properties presumably changing as a result of cyclic strain aging of the specimen material during testing. Another entirely separate cause of the slower crack growth could be that it results from an effect of loading rates on the local plastic strain zones in which cyclic fracture occurs. As part of the crack initiation studies, tests of edge-notched ($k_t = 3$) flat plates at 550°F which are still in progress, show no discernible effect for $2\frac{1}{4}$ Cr–1 Mo steel, but a reduction roughly by a factor of two of fatigue life for plain carbon steel material. The reduction in comparison with room temperature data is evident for both cycles-to-crack initiation and to failure. Progress was made during the quarter in completing the prototype fatigue testing installation. Debugging and initial shakedown testing with light loading was conducted by deflecting the cantilevered end of a 20-foot pipe straight 1 to 2 in. to verify and calibrate strain gage output signals. (J.R.D.)

25626 (IA-1105) MULTIGROUP TRANSPORT PERTURBATION ALTAC CODE FOR THE PHILCO-2000 COMPUTER. Lemanska, M.; Yiftah, S. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec. 1966. 18p. Dep. mn.

PERTR is a first order perturbation code based on the multigroup multiregion transport equation for spherical geometry. It is programmed for the Philco-2000 computer in ALTAC mnemonic language. The code may be used to calculate a change in k_{eff} obtained by perturbations of the material cross sections in a single region of a reactor. The total and angular fluxes and adjoint fluxes required by the perturbation formula are obtained by SNG-TAC and SNGAD codes. (auth)

25627 (JAERI-1122) EFFECTS OF NUCLEAR DATA PRECISION ON CRITICAL AND BURNUP CALCULATIONS. Shindo, Ryuich; Yasukawa, Sigeru (Japan Atomic Energy Research Inst., Tokyo). 1967. 28p. (In Japanese). Dep.

In the criticality and burnup calculation of a reactor, the precision of nuclear data used is important. Effects of the accuracies in the nuclear data for fuel nuclides upon the criticality and burnup calculations, in the D_2O moderated lattices of the pressure tube type are reported. For the standard lattices fueled with uranium, the following were found: in the high energy region, the fission cross section and the number of fast neutrons per fission of fuel are important. The 10% deviation of these data gives a difference of about 0.5% in the effective multiplication factor and about 5% in the burnup. In the resonance energy region, the resonance integral of ^{238}U and the number of fast neutrons per fission of ^{235}U are important. And the 10% deviation in these values gives the changes of 2% and 0.5% respectively in the effective multiplication factor. At the burnup of 20,000 MW d/t, the effect of the resonance integral of ^{240}Pu becomes important. In the thermal energy region: the 10% deviation in the number of fast neutrons per fission and in the absorption cross section of ^{235}U results in the changes of 10% and 4% respectively in the effective multiplication factor. And the deviation of 10% in the ^{238}U absorption cross section to the changes of 2% and 10% in the effective multiplication factor and burnup, respectively. When the burnup of 20,000 MW d/t is attained, the effect of the deviation in the nuclear data of ^{239}Pu on the effective multiplication factor becomes about the same as that of ^{235}U. And in this thermal energy region, the deviations in the absorption cross section and number of neutrons per fission of ^{238}U, ^{239}Pu and ^{241}Pu give very large influences on the burnup. The 10% deviation in certain of the above nuclear constants, gives even change over 50% in the burnup. (auth)

25628 (KAPL-P-3320) DATATRAN: A DATA-HANDLING COMPUTER LANGUAGE FOR A LARGE MODULAR REACTOR DESIGN SYSTEM. Kopp, H. J.; Selengut, D. S. (Knolls Atomic Power Lab., Schenectady, N. Y.). [1965]. Contract W-31-109-eng-52. 13p. (CONF-670501-10). DTIE.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

DATATRAN data-handling language is developed for large modular reactor design systems. The system can be used by sections or wholly. It will also handle Fortran statements. The

program is designed for data manipulation, only, with orientation toward no specific application. Format-free input can be used since the system is syntax oriented. Storage and retrieval from the unstratified mass memory can be accomplished without knowledge of the specific memory unit involved. (M.L.S.)

25629 (KFK-508) UEBER DIE BEDEUTUNG DES ADJUNGIERTEN FLUSSES IN DER REAKTORKINETIK. (On the Significance of Adjointed Fluxes in Reactor Kinetics). Fischer, E. A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Jan. 1967. 37p. (In German). Dep. mn.

The neutron flux was defined and its properties were described. The explanation was made within the framework of the multigroup-diffusion theory since the diffusion theory is sufficiently accurate for many practical calculations. The information on physical magnitudes that can be obtained from the solution of the adjoint equations was considered. It was shown that the reactivity and some other nonobservable magnitudes can be so described that they have the same values in both the general description and the adjoint description. A mixed description can be given which leads directly to the known variation method. The perturbation calculation for reactor rates can be derived directly from the mixed description. The adjoint description was made explicit for application to the problem of a reactivity step. (J.S.R.)

25630 (ORNL-4071) NUCLEAR SAFETY PROGRAM ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1966. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 359p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The following broad topics are discussed in varying degrees of detail: simulated loss-of-coolant accidents experiments in the ORR; simulated transient accidents in TREAT; effect of high-temperature operation on fission-product migration and release in HTGR fuels; in-pile studies of the reactions of fueled graphite and the behavior of fission products under HTGR accident conditions; HTGR nuclear safety tests in ORR poolside capsule facility; LOFT parametric studies of the effects of time and temperature on fission-product release; behavior of I_2 and HI in the Containment Research Installation; behavior of fission products release from Zircaloy-clad high-burnup UO_2 in the Containment Mockup Facility; fission-product transport in the Nuclear Safety Pilot Plant (NSPP); steam-carbon reaction and fission-product release and transport studies; engineering-scale steam-graphite reaction experiments; desorption of fission products from a stainless steel surface in a steam environment; removal of radioactive methyl iodide from moist air systems; studies of aerosol behavior; filter tests in the NSPP; ignition of the charcoal adsorbers by fission-product decay heat; engineering manual for high-efficiency air filters; separation of noble gases from air by preselective membrane; removal of methyl iodide from air streams by Hopcalite; reactions of iodine vapor in containment systems; sampling devices for the characterization of accident-released fission products; characterization of radioactive particulate aerosols by the fibrous-filter analyzer; behavior of fission products in gas-liquid systems; high-temperature behavior of gasborne fission products; studies of CSE-type fission-product simulation; the cascade impactor as a tool for the study of size distribution of fission-product aerosols; chemical equilibrium studies of organic iodide formation under nuclear reactor accident conditions; fission-product release model; condensation model of fission-product transport in containment vessels; computation of chemical equilibria in fission-product-fuel mixtures; pressure vessel technology report; experimental and analytical investigations of nozzles in spherical shells and flat plates; investigation of variability of impact-test data and correlation between Charpy V-notch and drop-weight NDT data for low-alloy steels; studies of casks for shipping irradiated fuel; HTGR safety; underwater caisson containment for offshore siting of water-cooled power reactors; antiseismic design of nuclear facilities; adequacy of scaleup in experiments on fission-product behavior in reactor accidents; Nuclear Safety Information Center; nuclear safety—a technical progress review; and discussion papers on various aspects of water-cooled reactor safety. (M.L.S.)

25631 (ORNL-4078) EXTERMINATOR-2: A FORTRAN IV CODE FOR SOLVING MULTIGROUP NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS. Fowler, T. B.; Tobias, M. L.; Vondy, D. R. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 94p. Dep. CFSTI.

EXTERMINATOR-2 is a FORTRAN IV version of the code EXTERMINATOR with major improvements. The code embodies all the features of EXTERMINATOR and, in addition, can be used to search for criticality directly or indirectly by varying nuclide concentrations, take into account equilibrium Xe effects, and compute adjoint fluxes and do perturbation calculations. Variable dimensioning techniques were used in programming the code that allow easy adaptation to any computer with a FORTRAN IV compiler and a minimum core size of approximately 64K words. The code contains no assembly language coding. Succeeding cases require only those input-data that are different from the input for the preceding case, and the code uses I/O devices during the iterative part of the calculation only when core storage is exhausted. (auth)

25632 (ORNL-P-2979) SUBCRITICALITY MEASUREMENTS BY NEUTRON NOISE ANALYSIS. Roux, D. P. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 7p. (CONF-670314-1). Dep. CFSTI.

From Liquid Metal Instrumentation and Control Sympsoium, Idaho Falls, Idaho.

An analysis of the possible applicability of reactor noise to measure reactor parameters at subcritical levels is given. The feasibility of application in the LMFBR is investigated. Detector efficiency, equipment problems for higher break frequencies, and validity of approximation models are considerations given cursory analysis. (M.L.S.)

25633 (TRG-Report-1338) TECHNIQUES USED AT WINDSCALE IN THE ZERO-ENERGY REACTOR HERO AND SUB-CRITICAL STACK FIFI FOR THE MEASUREMENT OF NEUTRON FLUX AND POWER GENERATION DISTRIBUTION IN A.G.R. LATTICES. Collinson, B.; Higham, E. J.; Rowbotham, J. R. (United Kingdom Atomic Energy Authority, Sellafield (England). Reactor Group). 1967. 28p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 4s. 6d.

For the power generation evaluation of a heterogeneous advanced gas-cooled reactor, a knowledge of the gross distributions of thermal flux and fission rate over the core and their fine structure within lattice cells is required. To test methods of calculation of these distributions a series of measurements have been made at Windscale for a range of fuels and lattices. The measurements necessary and the accuracy required are discussed, together with the range of situations covered by the investigations. The experimental facilities for irradiation and counting available in the zero-energy reactor HERO and the sub-critical stack FIFI are described, and the techniques of measurement and analysis discussed. Typical results are given; errors of ±1% or less were achieved using the techniques of measurement developed, thus satisfying the accuracy requirements for power design evaluation and for the testing of the theoretical methods. (auth)

25634 (UCRL-70012) APPLICATION OF ASYMPTOTIC DIFFUSION THEORY METHODS TO SMALL SYSTEMS. Doyas, R. J.; Koponen, B. L. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1967. Contract W-7405-eng-48. 15p. (CONF-670501-7). Dep. CFSTI.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

It is shown that by using more precise solutions to the standard boundary value problems, an improvement can be made in the accuracy of diffusion theory methods for one-region fast systems. The method is not difficult to incorporate in the diffusion theory codes, and can increase their utility for work on small, fast reactors. (J.R.D.)

25635 (UJV-1663) TEPLOTNI POLE VICEVRSTVOVEHO STINICIHO BLOKU REAKTORU. (Temperature Distribution in a Nuclear Reactor Shielding Block). Pfann, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1966. 39p. (In Czech). Dep.

The methods of calculating the temperature distribution in the shielding block of a nuclear reactor are described. The calculation is carried out in the one-dimensional, plane, cylindrical or spherical geometry arrangements with inner cooling. Design scheme-size, material composition, cooling method and the character of heat development throughout the volume are assumed to be given. The methods are completed with the program for the computer Gier in the ALGOL language which enables the determination of temperature distribution, heat development in particular zones, heat quantity transmitted between the zones, maximum block temperature and the coordinates of this temperature. (auth)

25636 (UJV-1704) METODIKA VYPOCTU LOKALNIHO VYHORENI TEZKOVODNICH REAKTOROVYCH MRIZI. (Calculations for Local Burn-Up in a Heavy Water Reactor Lattice). Kujal, B.; Kujal, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov. 1966. 23p. (In Czech). Dep.

A method of calculating particular physical reactor parameters as a function of burn-up is given. The method is applicable to high burn-up values, also. (auth)

25637 (UNC-5174) PERFORMANCE EVALUATION OF HEAT EXCHANGERS FOR SODIUM-COOLED REACTORS. Quarterly Technical Progress Report, January 1, 1967-March 31, 1967. Israel, S. L.; Nolan, D. J. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Apr. 20, 1967. Contract AT(11-1)-1452. 65p. Dep. CFSTI.

Progress on the evaluation of the thermal-hydraulic and structural performance of heat exchangers for sodium-cooled reactor plants is reported. Shakedown of the evaluation procedures for the heat exchangers was continued. The observed performance of the intermediate heat exchanger was considerably better than predicted. This was not considered conclusive because of the small terminal temperature difference recorded during the rise-to-power test on which the analysis was based. It was noted that a heat transfer coefficient on the shell side of the intermediate heat exchanger was previously misapplied and the over-all heat transfer coefficient was previously incorrectly defined. Correction of these led to a more conservatively designed unit. Stresses were calculated for the lower tubesheets of the heat exchangers. Comparisons of the stresses based on several temperature distributions were made. These show that the magnitude of stresses is very sensitive to these distributions. Results of analyses of possible damage resulting from tube vibration were reviewed. The feedwater inlet header of the steam generator was analyzed using computers. The results compare favorably with those calculated previously. (J.R.D.)

25638 (WAPD-TM-638) NEUTRON LEAKAGE EFFECTS ON THE FAST ADVANTAGE FACTOR IN A SEED-BLANKET ASSEMBLY. Glickstein, S. S.; Beck, J. W.; Wheat, L. L.; Hall, W. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr. 1967. Contract AT(11-1)-Gen-14. 19p. Dep. CFSTI.

Fast advantage factor measurements and calculations have been performed in a single module seed-blanket assembly containing a ThO_2 blanket and a highly enriched uranium seed. Large variations were noted in the advantage factors which were attributed to leakage effects due to the narrow seed region and the varying fast neutron source distribution through the core. One group, two-dimensional Monte Carlo calculations, with the MARC program approximating the explicit core geometry, are in agreement with the measured results. Calculations were also performed applying the principles of superposition and reciprocity to illustrate the dependence of the fast advantage factor on neutrons originating from various sections of a core. (auth)

25639 (WCAP-3269-53) FUEL MANAGEMENT IN A LARGE CHEMICAL SHIM CLOSED-CYCLE WATER REACTOR. Raje, S.; Petrie, D. H. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). May 1966. Contract AT(30-1)-3269. 139p. Dep. CFSTI.

A modified Out-In fuel management technique was applied to all the fuel loadings considered for the large chemical shim closed-cycle water reactor core. Three advanced cycles were included in the homogenized assembly study, with two different initial core loadings and two or three different feed enrichments. Zr-clad fresh fuel was substituted for stainless steel clad fuel in one part of the study. Calculated values for the homogenized study are compared to those from a discrete assembly study. Fuel loading schemes in the more detailed study are compared to those of the homogenized calculations. (M.L.S.)

25640 (ANL-Trans-425) INVESTIGATION OF THE DISTRIBUTION OF ADMIXTURES IN A TURBULENT FLOW OF A LIQUID-METAL COOLANT. Ivanovskii, M. N.; Orlov, Yu. I.; Subbotin, V. I. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from a paper presented at the IAEA Symposium on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna, November 29-December 2, 1966. 13p. (CONF-661110-25). Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

An experimental study of the distribution of undissolved admixtures (nitrogen) in a turbulent flow of Li coolant in dependence on various factors such as the temperature and rate of flow of the coolant and the direction of the thermal flux and the operating conditions of individual loops as well as of the entire flow circuit results are presented. A solution of the differential equation for the material balance of the admixture is given for the surface unit of the contact layer. (auth)

25641 (ORNL-tr-1525) WEIGHT OPTIMIZATION FOR RADIATION SHIELDS OF LARGE NUCLEAR REACTORS. Sasse, S. (Technische Hochschule, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1023, 92p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $8.60 fs, $2.96 mf.

Thesis.

Optimizing a shield concerns the configuration resulting in a minimum of weight, thickness, and cost. The lowest weight configuration is considered and, in particular, application in the construction of ship reactor shielding. General aspects and methods of optimization are reviewed and the calculations of radiation attenuation are given. The mathematical treatment of the attenuation of a reactor radiation for a homogeneous H_2-containing Ph-free shield is reviewed. The influence of Pb additions is investigated. Maximum permissible dose to neutrons and γ radiation is discussed. The performance of optimization of all considerations is entailed and an appendix includes dimensionless optimization calculations. (J.C.W.)

25642 MAINTENANCE PROBLEMS OF NUCLEAR POWER STATIONS. Cometto, M.; Gualtieri, G. (Ente Nazionale per l'Energia Elettrica, Rome). Neue Tech., 9: 70-80(Apr. 1967).

Nuclear stations are normally called upon to operate at high capacity factors, and therefore it is extremely important to set up proper maintenance programming and procedures. A few criteria are indicated which should be taken into account in the design of the plants and during operation; a description of the Italian experience is given. The Appendix lists and describes some maintenance jobs which presented special difficulties, and the main maintenance work performed at the three stations. (auth)

25643 THE ECONOMIC OPTIMIZATION AND OUTLOOK FOR ADDING NUCLEAR POWER STATIONS TO COVER SWISS POWER DEMANDS. Crastan, V.; Galli, R. B. (Suiselectra AG, Basel). Neue Tech., 9: 57-69(Apr. 1967). (In German).

The installation of thermal power in the Swiss network will increase the economic interest for the mathematical optimization of plant operation. The problems of momentaneous, daily, weekly, and yearly network optimization are discussed. As an example, the Swiss situation about 1980 is examined. (auth)

25644 EFFECT OF HIGH-GAIN BREEDERS ON NUCLEAR FUEL SUPPLY AND COST. Wright, J. H. (Westinghouse Electric Corp., Pittsburgh). Neue Tech., 9: 47-52(Apr. 1967).

A study of various breeder reactors is presented along with their resulting effects on nuclear fuel cycle costs and U requirements. It is pointed out that only a high-gain breeder, that is one having a doubling time shorter than the growth doubling time of industry, will provide a satisfactory solution to the long-range nuclear problems. Types of breeder reactors and their effect in breeder gains are summarized. (auth)

25645 MANAGING YOUR NUCLEAR FUEL. PART 3. NUCLEAR FUEL: GETTING THE MOST OUT OF IT. Gallagher, W. J.; Robbins, T. R. (NUS Corp., Washington, D. C.). Nucleonics, 25: No. 5, 29-31; 33; 35; 37; 39-40(May 1967).

The new operational problems facing the second-generation nuclear power plants are discussed. A comparison of increased fuel burnup versus uniform power distribution is given. Fuel economics of high-depletion cores is discussed. Projections of plant capacity and load factor, as they affect fuel management, are discussed. Refuelling patterns as a function of economics is considered. (M.L.S.)

25646 INDUSTRY PUSHES AHEAD IN FAST BREEDER DEVELOPMENT. Strauss, S. D. Nucleonics, 25: No. 5, 77-80(May 1967).

The present and predicted status of fast breeder reactors is discussed. The activities of the various firms engaged in fast breeder development are compared; the direction of activities is discussed. (M.L.S.)

25647 THE TURBINE BOTTLENECK: VENDORS EXPAND PRODUCTION TO MEET HUGE NUCLEAR DEMAND. Newburger, Roger. Nucleonics, 25: No. 4, 64-5; 70(Apr. 1967).

Activities at General Electric and Westinghouse aimed at expanding their capacity to produce turbine-generators are summarized. It is noted that utility demands have pushed the lead time for nuclear plants to nearly seven years. Fossil-fired plants take almost as long. (J.R.D.)

25648 COMPARISON OF SHIELDING CALCULATIONS FOR A POWER REACTOR SHIELD WITH MEASUREMENTS ON A SHIELD MODEL. Schultz, H. (Technische Hochschule, Hanover); Futtermenger, W.; Stiller, G.; Weber, H. Nukleonik, 9: 1-14(Jan. 1967). (In German).

On a shield model consisting of D_2O, B steel, steel, and baryte concrete, the spatial distribution of neutrons (thermal, epithermal, and fast) and the γ dose were measured. The results were compared with calculations which were made for the neutron distribution by a removal multigroup method. The measurement and calculation methods were described and the results discussed. In the absolute values for the fluxes and activities decaying over 6 decades, deviations up to 50% were found between theory and experiment with the exception of the thermal and epithermal flux in B steel where larger deviations occurred. The relative pattern agreed up to the expected exceptions up to the limits of error (and average of approximately ±20%). (tr-auth)

25649 AN AGR FOR EXPORT AT £36 PER kW. McLoughlin, J. H. (Fairey Engineering Ltd., Stockport, Eng.). Nucl. Eng., 12: 286-92(Apr. 1967).

A low capital and fuel cost reactor which is safe and reliable can be provided by means of a combination of design, quantity production, and financial incentive. The central entry cooled

(CE AGR) design proposed incorporates modification of the coolant flow pattern through the core to reduce pumping power losses, dispensing with internal shields, redesigning boiler to reduce cost and size, and substituting off-load for on-load refuelling. The design of a 600 MW plant is presented and the costs and financing are discussed. (UK)

25650 OPTIMAL SYSTEM OPERATION WITH STATE RESTRICTIONS. Lewins, Jeffery. Nucl. Energy, 53-7(Mar.-Apr. 1967).

A classical formulation of Pontryagin's optimal control theory is given. Application of the theory is demonstrated to the problems of time optimal control, minimum wasted energy, and minimum energy in regard to optimum nuclear reactor control. (UK)

25651 FRENCH NUCLEAR POWER STATIONS. Leo, Bertrand (Electricite de France, Paris). At. Strom, 13: 33-6 (Feb.-Mar. 1967). (In German).

A review of the technical development of the French nuclear power stations is given. Beginning with the installations in Marcoule, descriptions of the installations at Chinon, Saint-Laurent, and Bugey and the engineering which is typical for these installations are described. A forecast of future development is discussed. (ATSTA)

25652 PRESSURE-GLASS CABLE BUSHINGS FOR REACTOR SAFETY CASINGS. Borst, Alexander (Siemens-Schuckertwerke AG, Erlangen, Ger.); Huhse, Peter; Petzold, Erich. At. Strom, 13: 27-32(Feb.-Mar. 1967). (In German).

Cable connections through a reactor safety casing must be constructed so that they are gastight and temperature resistant. A possible technical solution is the pressure-glass cable bushing, which was developed from the electrode bushings for mercury vapour rectifiers. On the basis of the physical principles of pressure-glass melting, a description is given of the special technical requirements for this new type of component for reactor engineering in regard to mechanical and electrical properties, and the constructional solutions. A report is also given on manufacture and installation. (ATSTA)

25653 EFFECTIVE HOT-CHANNEL FACTORS FOR "FLAT" POWER REACTORS. Judge, F. D.; Bohl, L. S. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucl. Sci. Eng., 28: 296-300 (May 1967). (KAPL-P-3139).

The confidence associated with the hot-channel analysis of the thermal performance of a given reactor must necessarily depend upon the number of limiting points in the core. That is, if there are N equally limiting hot channels, the probability of nonfailure is the single-channel probability of nonfailure raised to the Nth power. Usually, no account of this fact is taken in thermal analyses, which implies an acceptance of a reduction in confidence level if there is more than one limiting channel. A simple prescription is presented for determining an effective hot-channel factor that would maintain the same confidence level of a single-channel case. This effective hot-channel factor (f_N) is simply determined by equating the probability of any one of N channels (with hot-channel factors f) failing to the corresponding failure probability for a single pseudo channel with hot-channel factor f_N. It is shown that the effective hot-channel factor may be quite a bit larger than the single-channel factor if N is large. These results suggest that not all of the performance gain resulting from flattening power distributions (thereby increasing the number of limiting channels) should be quoted because of this increase. In addition, it is shown that flattening the power distributions until each channel is equally limiting does not lead to the maximum probability of nonfailure unless the thermal capacity of each channel is the same. (auth)

25654 THE APPLICATION OF LIE SERIES TO REACTOR THEORY. Mennig, J.; Auerbach, T. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Nucl. Sci. Eng., 28: 159-65(May 1967).

Lie series are power series solutions of differential equations, whose expansion coefficients can be derived from algebraic recursion relations. The method of deriving these relations is illustrated by solving three problems: (1) multigroup diffusion theory; (2) multigroup P_N theory in cylindrical geometry; and (3) space-independent xenon dynamics. It is shown that the Lie series formalism leads to considerable simplification in the analytical treatment of complex problems. (auth)

25655 ZERO-POWER EXPERIMENTS AT THE AVR NUCLEAR POWER STATION AND THEIR RESULTS. Hantke, Hans-Juergen; Drechsel, Wolfgang (Brown Boveri/Krupp Reaktorbau GmbH, Juelich, Ger.). At. Strom., 13: 24-6(Feb.-Mar. 1967). (In German).

The report on the zero power experiments and results at the AVR spherical-pile reactor is given. The reactivity value of the control rods (ρ AS) and the mean value of the temperature coefficient ($\bar{\Gamma}$) between 25 and 115°C were measured and found to be ρ AS = −2% and $\bar{\Gamma} = -1.35 \cdot 10^{-4}$/deg. (ATSTA)

25656 CAN HIGH-TEMPERATURE REACTORS CONTRIBUTE TO THE CHEAPENING OF ATOM CURRENT? Cautius, Werner. At. Strom, 13: 21-3(Feb.-Mar. 1967). (In German)

After a review of the development costs for high-temperature reactors it may be advisable to develop more than one advanced reactor system. By comparing a few reactor characteristics and the costs of the fuel circulation circuit, the chances of high-temperature reactors and of high-speed breeder reactors are assessed. (ATSTA)

25657 COMMENTS ON "STABILITY ANALYSIS OF A SAMPLED-DATA CONTROLLED NUCLEAR REACTOR SYSTEM." Marciniak, Thomas J. (Argonne National Lab., Ill.). Nucl. Sci. Eng., 28: 315-16(May 1967).

A brief discussion is presented on the control of a reactor system by means of a digital sampler. A method of analysis of stability for such a sample-data controlled system is presented. Sampling frequency criteria are discussed briefly. (M.L.S.)

25658 POINT-REACTOR THEORY OF ROSSI-ALPHA EXPERIMENT. Babala, Dusan (Institutt for Atomenergi, Kjeller, Norway). Nucl. Sci. Eng., 28: 237-42(May 1967).

On the basis of Kolmogorov's general theory of chain processes, a formula for a conditional count probability as measured by a certain type of time analyzer is derived and compared with the classical Rossi-α formula. The discrepancy between the Rossi-α formula and the experimental results reported by several authors is explained. It is shown that this discrepancy is due to the frequently misunderstood function of the time analyzer used. The mathematical technique employed in the paper is well suited for calculating the conditional count probabilities, which might possibly be measured by other types of time analyzers. (auth)

25659 DETERMINATION OF STABILITY DOMAINS IN POINT REACTOR DYNAMICS. Devooght, J. (Univ., Brussels); Smets, H. B. Nucl. Sci. Eng., 28: 226-36(May 1967).

Nonlinear stability criteria for reactors can only be used when the reactor is linearly stable at all equilibrium power levels. Four methods of analysis of nonlinear stability that can be used when the reactors are unstable above a certain equilibrium power are presented. The topological method and the second Liapunov method are often of no practical interest, while the Aizermann and Rosen methods are applicable irrespective of the complexity of the system. The different methods are compared in the case of a reactor with a prompt-positive temperature coefficient and a slow-negative temperature coefficient. (auth)

25660 PERTURBATION OF THE AXIAL NEUTRON FLUX DISTRIBUTION IN A PRESSURE TUBE REACTOR AS A RESULT OF COUNTER-CURRENT FUEL ELEMENT LOADING OF NEIGHBORING COOLANT CHANNELS. Oldekop, W.; Raue, R. (Siemens-Schuckertwerke, Erlangen, Ger.). Nukleonik, 9: 51-7(Jan. 1967). (In German).

A perturbation theoretical method for the calculation of the neutron flux in a pressure tube reactor with counter current fuel element loading (by directional refueling) was developed. The tridimensional problem was simplified with help of a perturbation theory in one dimension. The unperturbed case is characterized by overall equal burnup. The flux alteration with respect to the unperturbed case is given as a solution of an inhomogeneous equation system. For the solution method it is assumed that the reactivity changes caused by the perturbation is negligibly small. The method was tested on a simple example in which the exact solution was compared with that given from the perturbation theory. The perturbation of the axial flux distribution in D_2O-moderated KKN reactor was calculated. The calculations were made in one and two dimensions. The maximum deviation for the cosine distribution with respect to the unperturbed flux at the same place amounts in one dimensional calculation to 1.3% for the thermal and 6.8% for the epithermal flux. (tr-auth)

25661 EFFECTS OF FUEL MANAGEMENT ON PERFORMANCE OF FAST-THERMAL COUPLED-REACTOR SYSTEMS. Prabulos, Joseph J. Jr.; Sesonske, Alexander (Purdue Univ., Lafayette, Ind.). Nucl. Appl., 3: 275-82(May 1967).

An evaluation is made of variations in reactor physics and engineering parameters during the core lifetime (100,000 MWd/mt) for a 1000-MW(e) fast-thermal coupled reactor containing oxide fuel material. The analysis includes a comparison between the thorium and plutonium breeding cycles, as well as an estimate of the effects of several types of fuel management on reactor design variables. While the analysis indicates poor breeding characteristics for the particular design considered, the calculational methods developed and the relative parametric trends computed are of more general applicability. (auth)

25662 MATHEMATICAL MODEL FOR THE DESCRIPTION OF THE OPERATIONAL BEHAVIOR OF A REACTOR WITH CRITICAL FLOW. Palinski, Roman (EURATOM, Ispra, Italy). Nukleonik, 9: 245-52(Mar. 1967). (In German).

Under abnormal operating conditions of a power reactor a two phase flow of the fluid coolant becomes possible. The two phase flow of the coolant, as compared with the one phase flow, causes a higher pressure drop which is equivalent to a reduction of the weight flow rate. This can lead for instance after a failure in the power supply of the coolant pump—if no right measures are taken—to a burn out of the fuel elements. A mathematical model is established for the design of the reactor components under a dynamical point of view, which describes the emergency power supply unit as well as the coolant loop of a power reactor. The numerical calculations are performed with the specific data of a projected and constructed power reactor. Afterwards the curves got from the analog computer are discussed. (auth)

25663 THE COURSE TAKEN FOR THE COMPLETION AND SUBSEQUENT OPERATION OF THE FIRST JAPC REACTOR. Tsujimoto, Susumu (Japan Atomic Power Co., Tokyo). Genshiryoku Kogyo, 12: No. 10, 17-31(Oct. 1966). (In Japanese).

The Tokai-Mura power station, the first JAPC reactor, went into continuous commercial power generation in July 1966. Vibrations in the heat exchanger tubing limit the maximum power output to about 110 MW(e). The various ideas considered before start of construction, the outline of the facilities, and the construction accomplished are discussed. Results of pre-neutron testing, fuel loading, post-neutron testing, and approach to power tests are presented. (TSS)

25664 STUDIES ON SAFETY ANALYSIS FOR A LOSS-OF-COOLANT ACCIDENT IN THE LIGHT-WATER POWER REACTOR. Fujie, Hideo; Yamauchi, Atsuo (Hitachi, Ltd., Tokyo). Nippon Kikai Gakkai Rombunshu, 69: 1068-76(Aug. 1966). (In Japanese).

In order to establish a method of safety analysis for loss-of-coolant accidents in light-water power reactors, several factors which influence the amount of fission products released from the reactor plant to the atmosphere were investigated experimentally. The temperature changes of the sheathed heaters, assembled in the same manner as for the JPDR fuel assembly, after start of the spray, was measured, and a method was found for obtaining the temperature change of the fuel rods after the loss of coolant. The flow rates of saturated water through the orifices of 10—70 mm diameter from the pressure vessel were measured and compared with Moody's theory. The calculated values by this theory were found to agree with the measured ones by the use of correction factors which depend on the orifice area. Heat transfer coefficients along the container walls were obtained with measuring devices installed in the mock-up container and the relationship between the heat transfer coefficient and the lapse of time, and the container inner-pressure were obtained. The relation between the container spray cooling-efficiency and the inner-pressure was obtained from the experiments using the mock-up container. (NSA of Japan)

25665 EXPERIMENTS ON THE PRESSURE-SUPPRESSION FACILITY FOR A LIGHT-WATER POWER REACTOR. Ichino, Ichiro; Sasaki, Mikio (Nippon Atomic Industry Group Co., Ltd., Japan). Nippon Kikai Gakkai Rombunshu, 69: 1077-84(Aug. 1966). (In Japanese).

In order to evaluate the functions of the pressure-suppression facility at the time of loss of primary coolant, an experimental pressure-suppression apparatus was constructed. Results of variation of the initial pressure of the pressure vessel, the area of a rupture, and the maximum pressures in the dry-well and pressure-suppression chamber were analyzed. Comparison was made with the experimental results. The following were concluded: the amount of flow per unit area out of the pressure vessel depends on the area of a rupture particularly when the area is large relative to the size of the pressure vessel; the maximum pressure in the pressure-suppression chamber is mainly determined by the volume of the dry-well and the amount released into the chamber from the pressure vessel; the initial peak pressure in the dry-well does not become its maximum pressure unless the area of the release pipe is extremely large or small. This maximum pressure is determined by the reactor pressure and the area of the rupture flow through the release pipe is two-phase; consequently, the maximum pressures calculated for the pressure-suppression chamber and dry-well with 100% carry-over do not agree with the experimental results. The percentage of water carried with the steam from the dry-well into the pressure suppression chamber is probably influenced by the construction and size of the dry-well and the position of the release pipe. (NSA of Japan)

25666 PROLATE ELLIPSOIDAL NUCLEAR REACTOR WITH A FINITE REFLECTOR. Chen, W. L.; Isbin, H. S. (Univ. of Minnesota, Minneapolis). Nukleonik, 9: 145-7(Feb. 1967).

An investigation of the prolate ellipsoidal nuclear reactor, a geometrical shape which can be adequately treated by the method of separation of variables is presented. Solutions are presented for the bare, homogeneous reactor, and the transcendental equation is derived for the finite reflected prolate ellipsoidal reactor. The reflector thickness effects have been evaluated for a specific example. (auth)

25667 THE NUCLEAR INDUSTRY IN THE EUROPEAN COMMUNITY. Baehr, P. Neue Tech., 8: 324-31(Dec. 1966). (In German).

The state of the European nuclear industry is reviewed with emphasis on power production. Nuclear power plants in operation, under construction, or planned are listed. (M.C.G.)

25668 FABRICATION OF NUCLEAR FUELS IN INDIA. J. Sci. Ind. Res., 25: 507-10(Nov. 1966).

India's experience with the fabrication of fuel elements of the CIRUS, a 40 MW(t) reactor, and Zerlina, a zero energy reactor for lattice investigations, is reported. Development and economics of technology for making fuel elements for power reactors are discussed. (P.C.S.)

25669 ECONOMIC AND TECHNICAL PROBLEMS CONCERNED WITH THE COOPERATION AMONG N.A.T.O. COUNTRIES IN NUCLEAR ENTERPRISES FOR PEACE. Di Loreto, Angelo (Rome Univ.). Riv. Ing. Nucl., 4: 943-5(Jan.-Feb. 1966).

A complete and up to date picture of the peaceful nuclear activities developed by the various member nations of NATO by virtue of the collaboration created among the Governments by the treaty is presented. An examination of what has been technically accomplished up until now and an analysis from a technical-economic point of view is given. The object of the author is to indicate the possibilities offered by the nuclear industry if it is helped by communal research and a free exchange of information. (auth)

25670 MONTE CARLO PROGRAM FOR THE TIME-DEPENDENT NEUTRON TRANSPORT FOR THERMAL PULSES IN LIGHT WATER. Fleck, C. M.; Hejtmanek, H.; Kopitsch, F. (Oesterreichische Hochschule, Vienna). Nukleonik, 9: 157-60 (Feb. 1967). (In German).

A program for the treatment of time-dependent neutron diffusion theory is given. Calculations are extended below the 1 eV range to include thermal neutrons. Bases for selecting Monte Carlo formulism are discussed; typical results obtainable with the code are given. (M.L.S.)

25671 MODIFIED STATISTICAL TECHNIQUE FOR THE MEASUREMENT OF α IN FAST AND INTERMEDIATE REACTOR ASSEMBLIES. Srinivasan, M.; Sahni, D. C. (Atomic Energy Establishment, Trombay, India). Nukleonik, 9: 155-7(Feb. 1967).

A method of measurement of prompt neutron decay is given. The method, called the correlation filtering technique, is based on the introduction of an artificial dead time into the pulse channel. This technique makes use of the exponential dependence of the correlation term on the dead time. (M.L.S.)

25672 ANALYSIS OF REACTOR POWER EXCURSIONS BY MEANS OF SOLUTIONS WITH ASYMPTOTIC EXPANSIONS. Caldarola, L. (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 9: 129-38(Feb. 1967).

The equations of the well known "constant power removal model" have been used. The stability of the system has been studied by means of the Liapounov function. A method is suggested to approximate a power excursion by its asymptotic expansion. All the functions of the asymptotic expansion have been calculated so that it is possible to evaluate them numerically. The necessary and sufficient conditions for the existence of the asymptotic expansion have been analyzed. Some numerical evaluations in the case of the Southwest Experimental Fast Oxide Reactor (SEFOR) have been carried out on the IBM 7074 computer. (auth)

25673 FUNCTIONAL ANALYSIS OF THE RANDOM PROCESSES IN NUCLEAR REACTORS. Dalfes, Abdi (Technical Univ., Istanbul). Nukleonik, 9: 123-9(Feb. 1967).

By first considering discrete cells in the phase-space a partial differential equation is determined which relates the probability generating function of the space and velocity dependent random processes in nuclear reactors. This equation transforms into a functional equation relating the probability generating functional when the processes are considered to be continuous in phase-space. The functional equation contains all the information pertaining to the analysis of nuclear reactors, since it yields, in particular, not only the transport equation, but also the equation

referring to the space and velocity dependent correlation functions of the state variables at a given time or at two different times. These equations can be expressed in terms of a single integro-differential matrix operator, whose fundamental role in the analysis of nuclear reactors is deterministic as well as stochastic. (auth)

25674 STOCHASTIC FLUCTUATIONS IN THE POWER BURST OF A REACTOR. Baers, Bruno (Technical Univ., Helsinki). Nukleonik, 9: 118-22(Feb. 1967).

The theoretical study of the statistical fluctuations in the power bursts of nuclear reactors with prompt negative temperature coefficients of reactivity is presented. The basic equation is a space- and energy-independent partial differential equation for the probability generating function which is related to the probability density function and which describes the state of the reactor. Neglecting the delayed neutrons in the transient state and assuming that the fission-, absorption- and leakage probabilities are linear functions of the stored heat energy in the fuel elements then the variance in the peak power and the released energy during a power burst is approximately solved. The relative variance in the peak power and the released energy is shown to be $\langle n_0^2 \rangle - \langle n_0 \rangle^2 / \langle n_0 \rangle^2$, where n_0 is the initial number of neutrons in the reactor. This expression is the same as relative variance for the neutron population in the pre-pulse steady state. (auth)

25675 ADVANCED THERMAL REACTORS AND FUEL CYCLE. Mochizuki, Hiroji; Tanaka, Ryokichi (Kawasaki Dockyard Co., Ltd., Japan). FAPIG (Tokyo), No. 40, 20-5(Apr. 1966). (In Japanese).

The fuel cycle for advanced thermal reactors (ATR) was examined for future installations of atomic power stations in Japan. In a comparative study of heavy-water reactors, the fuel economic advantage of French EL-500 type gas-cooled heavy-water reactors with Be cladding was investigated. The amounts of U required were studied for the various combinations of ATRs and the fast reactors. U could be conserved by changing part way to EL-500 type ATRs, in comparison to changing from light-water reactors directly to fast reactors. It was clarified that it was more advantageous to recycle some of the Pu produced in thermal reactors to ATRs and light-water reactors, than stockpiling it all for the fast reactors. (NSA of Japan)

25676 MANUFACTURE OF NUCLEAR REACTOR COMPONENTS. Bazeley, E. G. (Canadian General Electric Co. Ltd., Scarborough). Eng. J. (Montreal), 50: 22-8(Mar. 1967).

Some critical aspects of manufacturing nuclear reactor core components including quality control, producibility and development are described. NPD, WR-1 (Whiteshell) and CANDU at Douglas Point are the reactors discussed. (F.S.A.)

25677 CHEMICAL PROBLEMS IN NUCLEAR REACTORS. Lindhe, S.; Carlson, F.; Edwall, B.; Berlin, B. (Aktiebolaget Atomenergi, Stockholm). Svensk Kem. Tidskr., 79: 113-21 (1967). (In Swedish).

Chemical problems associated with operation of nuclear reactors cooled and moderated by water and steam are reviewed. Some radiochemical reaction in the coolants of pressurized and boiling water reactors are presented. Build-up and behaviour of radioactive corrosion products in out-core parts of the primary system and deposition on fuel element surfaces are discussed. Problems on purification of water and steam are briefly considered. (Swed)

25678 ONTARIO HYDRO'S NUCLEAR FUTURE. McRae, Ian F. Power Eng., 71: 59-60(Feb. 1967).

The present state of and future projects planned for nuclear-powered electric generator plants in the Canadian Province of Ontario are presented. The most recent forecast calls for one 500-MW nuclear unit to be placed in service each year from 1970 to 1975 inclusive. By 1980, nuclear power should account for one-third of the total predicted resources of more than 23,000 MW. The cost of electricity from coal will not be able to match the ultimate economics of nuclear generation. The cost at which nuclear energy becomes competitive should be improved at the Pickering nuclear station now under construction near Toronto. Canada's natural U reactor type is extremely economical in the use of U. The CANDU (Canadian Deuterium Uranium) system offers the best possibility of major cost savings, not only relative to other reactors but also to other forms of generation. Canada will soon make its own D_2O, and costs for this commodity will fall. The ability of CANDU reactors to use a mixture of natural U and Th also makes them highly desirable to many nations. The CANDU system is undergoing major changes promising substantial economies in the capital cost of the plant. (BBB)

25679 NUCLEAR REACTOR AND METHOD OF FUEL MANAGEMENT THEREFOR. Jaye, Seymour; Lee, Dana H. Jr.; Triplett, John R. (to U. S. Atomic Energy Commission). U. S. Patent 3,309,277. Mar. 14, 1967.

A process for recycling fuel, eliminating fission products and recovering bred ^{233}U is described. (auth)

25680 NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 1,066,264. Apr. 26, 1967. Priority date Nov. 15, 1963, United States.

A large pressurized water, U-seed, Th blanket power reactor is described. The coupled-core reactor contains highly enriched fissionable material. (J.C.W.)

25681 NUCLEAR REACTOR REFUELLING DEVICE. Aubert, Michel; Brouard, Daniel; Rouge, Pierre (to CEA). British Patent 1,066,519. Apr. 26, 1967. Priority date Nov. 18, 1964, France.

The design of a refueling device is described for gas-cooled and graphite moderated reactors. (J.C.W.)

25682 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. (to Societe Belge pour l'Industrie Nucleaire). British Patent 1,066,402. Apr. 26, 1967. Priority date Jan. 17, 1964, Luxembourg.

The improvement of the efficiency of a fast or intermediate nuclear reactor is discussed. The containment for the core of the reactor is constituted by a plurality of modules, resistant to high temperature and high pressure, and adapted to receive and enclose fuel elements and to act as ducts for the flow of heat-carrying fluid. (J.C.W.)

25683 NUCLEAR SAFETY. Volume 8, Number 3. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P. (eds.). Contract W-7405-eng-26. One of the five Quarterly Technical Progress Reviews published for the Division of Technical Information, USAEC. Oak Ridge National Lab., Tenn., Spring 1967. 80p. GPO $1.00 Domestic, $1.20 Foreign.

Information is presented in six sections containing a total of twelve articles. A separate abstract was prepared for each article. Miscellaneous information is included for which no abstract was prepared. (J.R.D.)

For abstracts of individual papers see: 24118, 24187, 24188, and 25684–25692.

25684 MERITS AND LIMITATIONS OF THE CONTROL-ROD-WORTH MINIMIZER. Bullock, J. B. Nucl. Safety, 8: 236-7 (Spring 1967).

The control-rod-worth minimizer concept as proposed for several boiling-water power reactors involves the application of an on-line digital computer to prevent maladjustment of the reactor control rods. This concept of minimizing the worth of a control rod requires a determination of the position of the poison section of a control rod that may have accidentally separated from its drive. The problem of making such a determination appears to allow the computer to be only a backup to manual rod control. (auth)

25685 SAFETY ASPECTS OF THE MOLTEN-SALT REACTOR EXPERIMENT. Haubenreich, Paul N. Nucl. Safety, 8: 226-35(Spring 1967).

Fluid-fuel and solid-fuel reactors differ in the kinds of accidents that can cause system damage. Some fluid fuels are susceptible to segregation, and filling accidents are more likely, but afterheat is more easily handled. The surviving fluid-fuel concept, the molten-salt reactor, is being developed into a thermal breeder. Safety analyses and experience have shown the MSRE to be safe, and no serious problems are expected in designing safe molten-salt breeder reactors. (auth)

25686 EXPERIMENTS AND ANALYSES IN FAST REACTOR SAFETY. Dickerman, C. E. (Argonne National Lab., Ill.). Nucl. Safety, 8: 220-6(Spring 1967).

Recent experimental and analytical work on the behavior of fast reactor cores under accident conditions is reviewed. Orientation of the safety-related investigations is discussed, development of experimental equipment and techniques is summarized, experimental results are described, and the status of associated analytical tools is presented. Intensive investigations of the effects of coolant on fuel failure and fuel movement and on transient coolant vaporization and hydrodynamics are beginning. (auth)

25687 NINTH AEC AIR-CLEANING CONFERENCE. Adams, R. E.; Ackley, R. D. Nucl. Safety, 8: 238-44(Spring 1967).

The following listing of major topics was covered at the ninth AEC Air-Cleaning Conference: (1) aerosol production in reactor accidents, (2) filtration of micron and submicron particles, (3) radioactive iodine and methyl iodide removal, (4) confinement and containment of radioactive material, (5) in-place testing of air cleaning systems, and (6) noble-gas studies. (M.L.S.)

25688 DESIGN TRENDS IN SYSTEMS FOR CONTAINMENT. Gall, W. R. Nucl. Safety, 8: 245-8(Spring 1967).

The recent trend toward nuclear power plants with greater capacities has led to renewed concern over the possibility of failure of the primary reactor vessel. This concern is reflected in ACRS reviews of designs for some of these larger reactors. Trends in the design and construction of containment include the use of reinforced and prestressed concrete and the possible use of prestressed concrete for primary reactor vessels without secondary containment is also being considered. Recent publications include a compilation of current reactor-containment technology, a section of the ASME Boiler and Pressure-Vessel Code devoted to nuclear vessels, and an American Standard relative to steel containment shells. (auth)

25689 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Whetsel, H. B. Nucl. Safety, 8: 260-76(Spring 1967).

The various nuclear safety research and development projects are discussed. These include projects under the broad headings of light-water-reactor safety, Na-cooled fast reactor safety, gas-cooled reactor safety, transportation and storage, radionuclide release and movement in the environment, operational safety, and ground safety studies. (M.L.S.)

25690 AEC ADMINISTRATIVE ACTIVITIES. Blakely, J. P. Nucl. Safety, 8: 277-81(Spring 1967).

The JCAE recommended amendments to the Price-Anderson Act on nuclear incident indemnification are given. A discussion of the proposed legislation for financial aid from the AEC to the states to defray the cost of establishing and maintaining a uniform records and reports system for radiation workers is presented. The ACRS recommendation on areas of reactor safety where more research is needed and the letter pointing this out are presented. Discussions on quality assurance of reactor materials, design, and fabrication from the Pittsburgh ANS meeting are given. (M.L.S.)

25691 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. Nucl. Safety, 8: 281-92(Spring 1967).

A general outline of projects undergoing review is presented. Tabulations of reactors which have undergone change since the last review, and those which have not undergone any change, are given. Recent activity in reactor licensing is presented. (M.L.S.)

25692 CHANGES IN LICENSING REGULATIONS. Blakely, J. P. Nucl. Safety, 8: 293-5(Spring 1967).

A list of changes in AEC procedural regulations is given. Changes or proposed changes will affect 10 CFR Parts 9, 20, 32, 40, 50, 150, 35 and 70. Some discussion is presented on the proposed changes to Part 35 10 CFR and Part 150 10 CFR Section 274. (M.L.S.)

25693 IMPROVEMENTS IN LIQUID SURGE RESERVOIRS AND IN PRESSURE-GENERATING LIQUID SURGE RESERVOIRS, OR PRESSURIZERS, ADAPTED FOR USE WITH SYSTEMS OPERATING WITH FLUID UNDER PRESSURE. (to Babcock and Wilcox Co.). British Patent 1,064,299. Apr. 5, 1967. Priority date Dec. 12, 1962, United States.

The pressurizers serve as a steam boiler having zero steam output, the generation of the steam serving to impose a pressure on the primary coolant system through a surge line connecting the pressurizer and the primary coolant system circuit. The pressurizers impose a pressure on the fluid in a closed primary coolant system circuit of a pressurized water nuclear reactor to prevent boiling of the water in the circuit. (J.C.W.)

25694 IMPROVEMENTS IN OR RELATING TO NUCLEAR VAPOR GENERATING PLANT. (to Babcock and Wilcox Co.). British Patent 1,068,080. May 10, 1967. Priority date Nov. 15, 1963, United States.

A nuclear vapor generating plant including a reactor core, a steam generator, and a primary coolant pressurizer incorporated within one vessel is described. Employing the once-through type of operation, the reactor plant size is reduced. (J.C.W.) (J.C.W.)

25695 MEANS FOR MOUNTING POWER TUBES IN A NUCLEAR REACTOR. Boiron, P. G. (to Communaute Europeenne de l'Energie Atomique). Canadian Patent 753,710. Feb. 28, 1967. Priority date July 30, 1962, France.

The design of a suitable device for containing the fuel rods in a power reactor vessel is described. Means of support, coolant supply lines, allowance for expansion and fuel changing arrangements are discussed with emphasis on fluid tight seals. (F.S.A.)

25696 CONCRETE PRESSURE VESSELS FOR NUCLEAR REACTORS AND METHOD OF MANUFACTURING THE SAME. Ziegler, A. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 752,118. Feb. 7, 1967. Priority date Mar. 2, 1963, Germany.

The inner cavity of the pressure vessel is assembled at the site from prefabricated trapezoidal-shaped sections and is equipped with prestressing elements on the outside. Following assembly, rated pressure is applied and the widened butt gaps which develop between components are filled with pressure-resistant material. Pressure is applied with a large balloon of elastic material inflated with water. An inside steel liner prevents penetration of the gaps by the balloon. (F.S.A.)

25697 SPECTRAL SHIFT REACTOR CONTROL. Winsche, W. E. (to U. S. Atomic Energy Commission). U. S. Patent 3,310,473. Mar. 31, 1967.

A control arrangement for a fast fission nuclear reactor in which the neutron cross-section spectrum of the coolant is altered is described. The reactor is cooled by liquid Na whose nuclear cross-section is varied for control purposes by altering the amount of Li which is in solution. A device located in a bypass stream of the Na selectively increases and decreases the Li content by establishing Li-rich and Na-rich phases of the liquid metal mixtures and uses temperature to effect the particular compositions of these phases. (auth)

25698 PRESSURE-TUBE NUCLEAR REACTOR INCLUDING FUEL ASSEMBLY WITH THERMAL BAFFLE. Balog, Leonard J. (to U. S. Atomic Energy Commission). U. S. Patent 3,309,280. Mar. 14, 1967.

A fuel element assembly for a pressure-tube nuclear reactor wherein a plurality of fuel rods are positioned within and held nested together by a flat-sided flow baffle is described. A hollow cylindrical thermal baffle surrounds the flow baffle and apertures near the inlet end of the flow baffle provide stagnant primary coolant between the baffles. (auth)

25699 NUCLEAR REACTOR. Vendryes, Georges; Zaleski, Casimir (to Commissariat a l'Energie Atomique). British Patent 1,069,025. May 17, 1967. Priority date Aug. 27, 1964, France.

A method of operation of a fast reactor is given. This consists of dividing the core into two regions which have symmetry of revolution with respect to a common axis parallel to the coolant flow direction. Both regions have the same amount of fuel; however the amount of fuel per unit volume varies from region to region. (M.L.S.)

25700 NUCLEAR REACTOR. (to United States Atomic Energy Commission). British Patent 1,069,362. May 17, 1967. Priority date Nov. 15, 1963, United States.

A design is given for a seed-blanket thermal reactor. The blanket element is of fertile material arranged heterogeneously and consists of depleted uranium. The seed assemblies are made up of thermally fissionable material uniformly distributed in the blanket. (M.L.S.)

25701 NUCLEAR REACTOR. (to United States Atomic Energy Commission). British Patent 1,069,230. May 17, 1967. Priority date Mar. 26, 1965, United States.

A design is given for a core for a gas-cooled water-moderated reactor. The core is made up of an array of moderator tubes and fuel elements filling the spaces between them so that a continuous fuel matrix is formed around the moderator tubes. (M.L.S.)

Marine and Portable Power Reactors

Refer also to abstract 25641.

25702 (NYO-10736) REFUELING AND REPAIRS OF THE PM-3A DURING THE 1964-65 AUSTRAL SUMMER. (New York Operations Office (AEC), N. Y.). July 1965. 57p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Operations were conducted at the PM-3A nuclear power plant, McMurdo Sound, Antarctica, to perform repairs and refuel. Fuel transfer system repairs and removal of the irradiated core were performed. Insertion of a new core and other repairs were also accomplished. Xe and I_2 activity in containment required cleanup and purge. One actuator rod bundle stuck during removal due to deformation of a latch finger collet. Examination of all collets revealed progressive deformation and were redesigned. Development is underway to provide improved actuator mechanisms. A hydrogen fire in containment damaged the fuel transfer dolly which operates through an interconnect between primary and spent fuel tanks. To provide access for repairs, 10,000 gallons of shield water had to be removed and stored. Prior to refilling shield water, several hairline cracks were discovered in the stainless steel clad of the containment tanks at omega seals in the interconnect-tank connections and were repaired. The core, handled as a unit

with control rods locked in place, was removed and the new core was inserted. Examination indicated water damage in all cables and electrical malfunction in two actuator coils. Emergency replacement of cables and repair of actuators were accomplished in the U. S. Criticality was achieved and after evaluation of a malfunction, which resulted in loss of fluid in the shell side of the steam generator, station load was assumed. (J.C.W.)

Rocket and Space Reactors

Refer also to abstract 24249.

25703 (NASA-TN-D-3840) MAPPING A TUNGSTEN-REACTOR ROCKET ENGINE AS A GUIDE TO OPERATION AND CONTROL. Cavicchi, Richard H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 89p. CFSTI.

A one-dimensional, nonlinear analog simulation of a preliminary tungsten water-moderated reactor system was used to map system performance over a wide range of steady-state operation. Mapping was conducted by using hydrogen mass-flow rate and chamber temperature as independent variables. These parameters were varied over a range from 20 to 120% and from 67 to 135% of design, respectively. The steady-state maps obtained are interpreted and conclusions are drawn concerning various aspects of system operation and control. (H.D.R.)

25704 (NASA-TN-D-3931) COOLDOWN CHARACTERISTICS OF REGENERATIVE NOZZLE USED IN FULL-SCALE, COLD-FLOW, NUCLEAR ROCKET TEST FACILITY. Turney, George E.; Cox, Eileen (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 60p. CFSTI.

Transient pressure-drop heat-transfer characteristics of a regeneratively cooled nozzle subassembly used in startup tests conducted with a full-scale, unfueled, nuclear rocket simulation system were made from both analytical and experimental standpoints. The pressure-drops and heat-transfer rates with gaseous, two-phase, and subcooled liquid hydrogen flow in the nozzle assembly were computed and compared with experimental measurements. (M.L.S.)

25705 (WANL-TME-1475) NRX/EST TRANSFER FUNCTION MEASUREMENTS BY CONTROL DRUM PERTURBATION AND COMPARISON WITH COMMON ANALYSIS MODEL PREDICTIONS. Steiner, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Nov. 1966. Contract SNP-1. 136p. Dep. CFSTI.

Transfer function measurement tests were performed on the NRX/EST nuclear rocket test system. The purpose of these tests was to obtain quantitative information on the dynamic characteristics of the basic system without controllers, to assess the advantages and disadvantages of three different methods of transfer function measurement, and to permit comparison of the response of the common analysis model used for system design and prediction with experimental results. Cross-correlation methods of transfer function measurements are compared with sinusoidal and step response results. Transfer functions were also predicted by the modified CAM-IIC computer model and were compared with experiment results. (M.L.S.)

25706 WHITHER NOW SNAP 8. Hanchett, James. Nucleonics, 25: No. 5, 54-7(May 1967).

A general discussion of the SNAP-8 program is presented. Fuel testing and turbine assembly status are briefly considered. A projection of the SNAP-8 power output beyond the present 35 kwe rating is discussed. (M.L.S.)

25707 VORTEX ROCKET REACTOR. Colgate, Stirling A. (to U. S. Atomic Energy Commission). U. S. Patent 3,307,357. Mar. 7, 1967.

A fission reactor for rocket propulsion and a method for energizing a propellant are described. The fission reactor defines a generally cylindrical cavity into which a preheated propellant is tangentially injected and isothermally expanded under constant angular momentum conditions by radiative heat transfer from the reactor walls. The propellant traverses the cavity with a vortex motion accompanied by a continuous increase in rotational kinetic energy which is transformed into axial energy of high specific impulse in the exhaust nozzle. (auth)

25708 GASEOUS VORTEX FOR A ROCKET MOTOR. Rom, Frank E. (to U. S. Atomic Energy Commission). U. S. Patent 3,270,496. Sept. 6, 1966.

A gaseous nuclear rocket propulsion system in which propellant and gaseous fuel are mixed with a resulting gaseous fission vortex being formed in the combustion chamber is described. The propellant passes through this vortex obtaining a high specific impulse as it is exhausted through a rocket nozzle. (auth)

Process Heat and Desalination Reactors

25709 (ORNL-TM-1618(Pt.2)) NUCLEAR DESALINATION DUAL-PURPOSE PLANT CONTROL STUDIES INTERIM REPORT APPENDIX. Ball, S. J. (Oak Ridge National Lab., Tenn.). Jan. 10, 1967. Contract W-7405-eng-26. 149p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

General methods have been developed for predicting the dynamic behavior of a large dual-purpose plant consisting of a pressurized-water reactor (PWR), a back-pressure turbine generator plant, and a multistage flash (MSF) evaporator. A flexible digital computer code has been developed which calculates the transfer functions for single-effect MSF plants. Preliminary results were obtained for a 250 MGD reference plant and some of the major control problems were determined. An analog computer study was made of a reference PWR plant, and transfer functions for a large back-pressure turbine were derived. (auth)

25710 (RL-GEN-925) USA-MEXICO DESALTING PLANT STUDY: GRAPHITE-MODERATED REACTORS WITH OXIDE OR METALLIC FUEL. Robinson, R. K. (comp. and ed.) (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Apr. 15, 1966. Contract AT(45-1)-1350. 73p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A two-reactor (5000 MW each) plant to supply heat to a desalination plant is described. The two graphite-moderated reactors are in separate containment vessels. The physics parameters for the desalination study are calculated. The new Production Reactor design is compared with that of the proposed desalination reactor. Research and development progress related to graphite, Zircaloy pressure tubes, fuel, carbon steel, and control rods is summarized. A cost summary is included. (J.C.W.)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 24274, 24409, 24736, 25633, 25668, and 25676.

25711 (ANL-7281) MEASURED PHYSICS PARAMETERS IN A ZONED FAST URANIUM CARBIDE CORE, ASSEMBLY 4Z. Karam, R. A.; Ancarani, A.; Helm, F. H.; Kato, W. Y.; Main, G. W.; Rusch, G. K. (Argonne National Lab., Ill.). Dec. 1966. Contract W-31-109-eng-38. 48p. Dep. CFSTI.

Assembly 42 of 2PR-6 is a zones cylindrical core with a central region having the composition of a 2600-liter carbide core, assembly 5. Assembly 4Z is designed so that the neutron-energy spectrum and the importance spectrum at the center are the same as those for assembly 5. The major objective associated with the zoned core is to test, in conjunction with the full-scale system, how well reactor physics parameters for assembly 5 can be predicted from the zoned-core measurements. (J.C.W.)

25712 (BAW-3647-03) PHYSICS VERIFICATION PROGRAM. Final Report. Clark, R. H.; Baldwin, M. N.; Pettus, W. G.; Pitts, T. G.; Flickinger, R. B. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Mar. 1967. Contract AT(30-1)-3647. 188p. Dep. CFSTI.

A program to determine the nuclear properties of water-moderated, slightly enriched, uranium dioxide lattices perturbed by clusters of Ag-In-Cd poison pins and dissolved boric acid is described. Core parameters and configurations typical of those in water-moderated power reactors were studied. The unperturbed basic lattice consisted of 0.475-inch-OD rods of 2.46%-enriched UO_2 on a square lattice pitch of 0.644 inch, and core radii varied from 19 to 65 cm. Boric acid, in concentrations from 0 to about 1500 ppM, was dissolved in the moderator to control excess reactivity. Power reactor fuel elements, incorporating clusters of Ag-In-Cd poison pins and typical structural material, were simulated in the central region of the largest core. Measurements were made of critical size, reactivity worth of poison pins, buckling, reflector savings, thermal disadvantage factor, epithermal absorption in ^{238}U, conversion ratio, neutron spectrum, radial and axial power distribution, and temperature coefficient. Experimental results of the program, many of which have been reported in quarterly technical reports, are presented. In some cases the data have been re-analyzed, and the reported results may differ slightly from those reported earlier. (J.R.D.)

25713 (BNL-11243) HFBR START-UP EXPERIMENTS. Sastre, Cesar A. (Brookhaven National Lab., Upton, N. Y.). Mar. 1967. Contract AT(30-2)-Gen-16. 6p. (CONF-670501-4). Dep. CFSTI.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

Experiments were conducted to determine the effects of He coolant pressure changes on reactor vessel strains associated with core and control rod movements. Other tests were conducted to determine the effects on reactivity of uniform core and temperature changes, sample insertions in the irradiation facilities, and voiding the irradiation tubes. Checks of subcriticality in partially loaded core configurations were made. Measurements of Xe poisoning were made at 1, 3, and 37 MW. (J.R.D.)

25714 (BNL-11245) MEASUREMENTS OF THE NEUTRON BEAM CHARACTERISTICS IN THE BROOKHAVEN HIGH FLUX BEAM REACTOR. Weinstock, Eugene V. (Brookhaven National Lab., Upton, N. Y.). Mar. 1967. Contract AT(30-2)-Gen-16. 28p. (CONF-670501-5). Dep. CFSTI.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

The beam characteristics measured are associated with the thermal, epithermal, and fast neutron fluxes. Other characteristics measured are associated with the spatial distributions of neutron fluxes across the beam tube thimbles, effective neutron temperatures, and gamma fluxes. The measurements were performed at reactor powers up to 10 MW, but all reported results were scaled up to 40 MW. (J.R.D.)

25715 (GEAP-5403) ACCURATE NUCLEAR FUEL BURNUP ANALYSIS. Twentieth Quarterly Progress Report, September-November 1966. Rider, B. F.; Ruiz, C. P.; Peterson, J. P. Jr.; Smith, F. R. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.). Dec. 1, 1966. Contract AT(04-3)-189. 86p. Dep. CFSTI.

The absolute Pu-239 thermal fission yields for stable Nd isotopes have been measured on a capsule containing highly enriched Pu-239 irradiated in the Materials Test Reactor for three cycles. The capsule was dissolved and analyzed by isotopic dilution mass spectrometry for the amount of each Pu and Nd isotope. The average Pu-239 thermal fission yields from three capsules analyzed to date for Nd-143, -144, -145, -146, -148, and -150 are given. A triple spike of U-233, Pu-242, and Nd-150 was calibrated for use in the determination of atom percent fission by isotope dilution mass spectrometry. (auth)

25716 (KFK-522) INVESTIGATION OF PROMPT NEUTRON KINETICS IN THE FAST-THERMAL ARGONAUT-REACTOR STARK BY NOISE ANALYSIS. Edelmann, M.; Murley, T. E.; Stegemann, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jan. 1967. 34p. (CONF-670107-7). Dep.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex.

Investigations of the prompt neutron kinetic behavior of the coupled system were made on STARK, The Fast-Thermal Argonaut-Reactor. Even with a power fraction in the fast zone of 31% the coupling between the fast core and the annular thermal driver region was found to be very strong. A theoretical method for investigating coupled systems is described. It is essentially a modal expansion of the flux which permits a rigorous treatment, within the limits of multigroup diffusion theory, of the space and energy dependence of the prompt neutron flux as well as the location and spectral sensitivity of the neutron detectors. The fundamental, or asymptotic, decay mode and the important higher modes were found, and the calculated decay of prompt neutron chains was compared with that measured by noise techniques. The experimental techniques applied for these investigations were the Rossi-α method and the probability distribution analysis. A description of the electronic systems is given including improvements regarding the logic circuitry of Rossi-α analyzers. Measurements have been performed in both the fast and thermal regions at various states of reactivity. Since the fast and thermal zones were very strongly coupled in this system, the theory did not predict and the measurements did not observe a single dominant fast decay mode attributable to the fast zone, but rather a transient response consisting of a few higher decay modes plus the asymptotic decay mode. In addition, the calculations predicted, and the measurements confirmed, that only the fundamental mode will be found with the detectors placed in the thermal zone, but that a few higher mode transients are observed in the signal with the detectors placed in the fast zone. The quantitative comparison of the calculated and measured transient part of the signal is affected by the statistical inaccuracies due to the shortge of experimental data. (auth)

25717 (NIJS-R-494) RADIATION MONITORING AND PROTECTION SYSTEM FOR THE REACTOR TRIGA MARK II AT THE NUCLEAR INSTITUTE "J. STEFAN", LJUBLJANA. Hanzel, S. D.; Cotman, K.; Gabrovsek, Z.; Kristan, J. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). Dec. 1966. 11p. Dep.

The requirements on the integrated instrumentation system for radiation monitoring are described. Special attention is put on the detection and the control of radiation hazards. A general treatment of the problems and equipment involved in process, effluent, area and personnel monitoring is given. The types of radiation encountered in the environment of nuclear reactor are discussed. A review of radiation monitoring equipment used in the plant and their sensitivity and reliability with regard to accepted standards for personnel and general public protection is given. (auth)

25718 (RT/FI-(66)37) REVIEW OF STATISTICAL METHODS FOR REACTOR PARAMETER MEASUREMENTS DEVELOPED AT C.S.N. CASACCIA. Pacilio, N. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1966. 37p. Dep.

The theoretical and experimental work has been devoted to the discrete approach of the noise analysis in nuclear reactors. Some statistical properties of the distribution of neutrons in a steady-state flux have been studied and some experimental procedures have been applied to measure prompt neutron decay eigenvalues, reactivity worths and reactivity dependent coefficients of some configurations of the R.O.S.P.O. reactor. The discussion of these measurements is divided into four sections; short-time-variance method, polya model method, zero probability method, endogenous pulsed source method. (auth)

25719 (TRG-Report-1429) GAMMA AND NEUTRON FLUXES IN THE DOUNREAY FAST REACTOR. Edwards, A. G.; Atkinson, H. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). Oct. 6, 1966. 22p. Dep. CFSTI. UK 3s. 0d.

The Dounreay Fast Reactor is operating as a fast flux materials testing reactor at a thermal power of 60 MW and centre flux of 2.5×10^{15} n/cm^2/sec. The values of γ and neutron fluxes throughout the core and inner breeder are required with greater precision for predicting rig conditions than they would be for operating the reactor as a power plant. Moreover experimental data must be obtained with minimum reduction in reactor load factor. The techniques and apparatus which have been adopted are described, and attention is drawn to the changed emphasis since the original commissioning experiments. Reactor modification has altered the flux profiles, and these are now explored using a minimum of spectrum-sensitive materials, and concentrating on speed and reliability of experimentation. Recently measured reaction-rate distributions are quoted for different rod configurations. A substantial attempt has been made to reproduce this information by calculation, and the progress of this work is described. It is concluded that none of the present data sets is really adequate for calculating DFR to the degree of accuracy required. Reference is made to work on γ heating rates in core and inner breeder. (INIS UK)

25720 (UCRL-70366) CONSIDERATIONS OF THE REFLECTOR EFFECT IN THE PULSED NEUTRON PROBLEM. Garelis, Edward (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1967. Contract W-7405-eng-48. 14p. (CONF-670501-9). Dep. CFSTI.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

The time-dependent Green's function for a reflected slab reactor is solved by using a simple one-group diffusion theory model. A better understanding of pulsed-neutron measurements for reflected systems was obtained. In the case of large reflectors the response appears to have a finite number of prompt decay constants. However, the results show that the prompt decay constants are determined by the system as a whole, and it is somewhat meaningless to ascribe separate decay constants to the core and reflector. The simple asymptotic period measurements yield reactivity values that are in close agreement with reactivity values that result from a static calculation. The reactivity calculated from a prompt decay measurement, k_1^*, is slightly larger than the reactivity calculated from an asymptotic period measurement, k_1^T; that is $k_1^* > k_1^T$. Numerically, for a light-water assembly that is about 3 dollars subcritical, there exists about a 4% difference between the two reactivities when compared in units of (1-k). (auth)

25721 A METHOD FOR ABSOLUTE DETERMINATION OF ^{238}U CAPTURE RATES IN FAST ZERO-POWER REACTORS. Seufert, H.; Stegemann, D. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Sci. Eng., 28: 277-85(May 1967).

A method for the measurement of absolute ^{238}U capture rates is described. The principle is based upon the fact that ^{243}Am and ^{238}U decay via ^{239}Np into ^{239}Pu. The α disintegration rate of ^{243}Am is determined absolutely by low geometry α-particle counting. From this, the absolute ^{239}Np disintegration rate follows directly,

which is measured by the 106-keV γ-x-ray coincidence technique. Therefore, the explicit knowledge of detector efficiency and decay-scheme data is not necessary, and also radiochemical separation is avoided. The absolute ^{238}U capture rate can then be obtained from the known ^{239}Np activity. The γ-x-ray self-attenuation within thick U foils is treated quantitatively and an optimum foil thickness is derived. Special attention has been given to the reduction and correction of background due to fission-product γ activity. A detailed error analysis shows an overall accuracy of about 1% for the absolute ^{239}Np disintegration rate including γ attenuation effects within the foils. To ascertain the reliability of low-geometry α calibration, comparison was made with the α-γ coincidence method. Agreement was found within the error limits of 1%. (auth)

25722 ANALYSIS OF CRITICAL EXPERIMENTS WITH ORGANIC-MODERATED ASSEMBLIES. Bitelli, G.; Martinelli, R.; Orestano, F. V.; Santandrea, E. Nucl. Sci. Eng., 28: 270-6(May 1967).

The results of critical experiments, performed with organic-moderated plate-type assemblies containing U enriched to 90% in ^{235}U, in the zero-power reactor ROSPO, are reported. Several cores, differing in critical radius and in ratio of U-to-stainless-steel plate number, have been investigated. The comparison with the reactivities calculated by a standard two-group calculation procedure shows an overestimate of the k_{eff}'s with a systematic dependence on the core radius. A satisfactory agreement is found for large-size cores. It is shown that simple calculational improvements, such as a four-group evaluation of the nuclear constants, and a more detailed treatment of core-radial reflector interface zone, lead to a homogeneously good agreement over the whole range of core dimensions. (auth)

25723 INTERVAL DISTRIBUTIONS IN NEUTRON COUNTING STATISTICS. Babala, Dusan (Institutt for Atomenergi, Kjeller, Norway). Nucl. Sci. Eng., 28: 243-6(May 1967).

Formulas for interval distributions of neutron counts, which open possibilities for new methods of reactor noise measurements, are derived. The proposed experimental techniques promise to be less time consuming than the zero probability method of Mogilner and Zolotukhin. The useful information contained in a sequence of counts lies in its deviation from Poisson statistics. The magnitude of this deviation depends either on the counter efficiency or on the intensity of the external neutron source. From this point of view, the techniques of noise measurements can be divided into two groups: the "efficiency sensitive" methods (Feynman) and the "power sensitive" methods (Rossi-α). The proposed count-to-count interval distribution measurement seems to combine the advantages of both groups. (auth)

25724 NEUTRON STREAMING IN AN ECCENTRIC REACTOR CHANNEL. Schneider, Hans; Palinski, Roman; Fassone, Gian (EURATOM, Ispra, Italy). Nukleonik, 9: 61-2(Jan. 1967). (In German).

The method used by Markl for the calculation of the streaming effect for a centrally placed channel in which a medium was introduced which was generalized by means of the Nordheim–Stalettar method developed from the control rod theory and was generalized to an eccentric channel. The results were applied to the Swedish heavy water reactor of the Cp-3 type, and good agreement was obtained between theoretical and measured values. (J.S.R.)

25725 DETECTOR RESPONSE TO THE SUBCRITICAL REACTOR. Walter, J. F. (Bettis Atomic Power Lab., West Mifflin, Pa.). Contract AT-11-1-GEN-14. Nucl. Appl., 3: 271-4 (May 1967). (WAPD-T-1906).

The interpretation of detector response to changes in a subcritical reactor is only qualitatively understood. In an experimental facility the detectors can be moved until adequate response is obtained. However, in a nonexperimental facility which lacks the flexibility to relocate detectors, it may not be possible to correlate changes in K_e with observed changes in detector response. A calculation model and method are derived and tested permitting quantitative interpretation of detector response to material and geometric changes in a subcritical reactor. (auth)

25726 CANNED-TYPE, CONTROL-ROD DRIVE FOR JMTR. Kiryu, Kiyomi (Hitachi, Ltd., Tokyo). Hitachi Hyoron, 48: No. 7, 19-22(July 1966). (In Japanese).

Construction of the ten control-rod drives, one in trial and nine operational ones, for the JAERI's JMTR at Orai, was undertaken by Hitachi, Ltd. The JMTR design is based on the ERR design of the United States. The canned type control-rod drive for this reactor was developed independently by Hitachi, Ltd. The test of mockup of the drive-rod has shown that it is superior to the conventional sealed-axis type. The specifications of its performance are as follows: normal operation: strokes—800 mm for the shim and safety control rods and 100–250 mm (variable) for the regulating rods; speeds—40 and 200 mm/min for the shim and safety rods and 0 ~ 2,000, mm/min (variable) for the regulating rods; scram: rod–drop time less than 40 ms and average dropping acceleration over 1 G; accuracy in the position indication to less than 1 mm. (NSA of Japan)

25727 HEAVY WATER LEAKAGE AND ITS COUNTERMEASURES IN JRR-2. Kobayakawa, Toru (Japan Atomic Energy Research Inst., Tokyo). Genshiryoku Kogyo, 12: No. 7, 27-32 (July 1966). (In Japanese).

A leakage of heavy water into the thermal-shield water from the JRR-2 reactor core occurred. Disassembly of the upper part of the reactor disclosed that the leakage had occurred at the packing of the circumference of the support ring for the heavy-water core. Leakage prevention was achieved by filling a part of the support ring with an epoxy binding agent, thereby enabling the repair work to be finished in a short period of time. Since the work had to be performed very close to the reactor core, adequate provision was made for the required tools and personnel. Out-of-pile rehearsal was held to minimize the working time of repair men. The heavy water leakage and its countermeasures are described in the following sections: construction of the reactor; locating of the heavy water leakage; investigation of the leaking place; cause for the leakage; adoption and execution of the repair works; and reassembly of the reactor and its condition after leakage repair. (NSA of Japan)

25728 FAST REACTOR CRITICAL ASSEMBLY FOR THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. Nagata, Kazuo (Fuji Electric Mfg. Co., Ltd., Japan). Fuji Jiho, 39: 629-36(Sept. 1966). (In Japanese).

A general description of the JAERI fast critical assembly is given. The present status of the fast breeder reactor for research and development is presented. (TSS)

25729 PROBLEMS IN CRITICAL CALCULATION FOR SMALL REACTORS. Nakamura, Shoichiro; Morita, Takahiro (Hitachi, Ltd., Tokyo). Hitachi Hyoron, 48: No. 8, 27-32(Aug. 1966). (In Japanese).

In the nuclear calculations for a reactor, extremely high precision is usually required. Since various approximation methods are available, considerable error can result from incorrect usage. For the case of small reactors, problems such as the neutron leakage in the axial direction, the treatment of fast-neutron group constants, and the error in the fabrication of reactor core elements exist; all of these have a large influence in the reactor design. These problems were examined by means of the measured values for the JAERI swimming-pool type reactor (JRR-4), and the extent of errors was clarified. When nuclear calculations were performed on the basis of this result, it was found that such calculations gave fairly accurate results for small reactors of the type similar to the JRR-4. (INIS-JAPAN)

25730 CENTRAL REACTIVITY MEASUREMENTS ON ASSEMBLIES 1 AND 3 OF THE FAST REACTOR FRO. Londen, Stig-Olof (Aktiebolaget Atomenergi, Studsvik, Sweden). Nukleonik, 9: 18-25(Jan. 1967).

The reactivity effects of small samples of various materials have been measured by the period method at the core centre of Assemblies 1 and 3 of the fast zero power reactor FRO. For some materials the reactivity change as a function of sample size has also been determined experimentally. The core of Assembly 1 consisted only of U enriched to 20% whereas the core of Assembly 3 was diluted with 30% graphite. The results have been compared with calculated values obtained with a second-order transport-theoretical perturbation model and using differently shielded cross sections depending upon sample size. Qualitative agreement has generally been found, although discrepancies still exist. The spectrum perturbation caused by the experimental arrangement has been analyzed and found to be rather important. (auth)

25731 STARK. Brueckner, Christian (Karlsruhe Nuclear Research Center, Ger.). Euratom Bull., 4: 118-24(Dec. 1966).

The construction and characteristics of STARK are discussed. The Karlsruhe Fast-Thermal Argonaut Reactor is a coupled reactor with two fission zones, one thermal and the other fast, interlinked and interdependent through the exchange of neutrons. Studies carried out at STARK are outlined. (J.C.W.)

25732 A MEASUREMENT OF THE TEMPERATURE COEFFICIENT OF THE RC-1 REACTOR (TRIGA) OF THE C.S.N. CASACCIA OF THE CNEN, ROME. Focaccia, G.; Marseguerra, M. Riv. Ing. Nucl., 4: 927-41(Jan.-Feb. 1966). (In Italian).

Some measurements of the temperature coefficients of the RC-1

reactor are reported; the procedure followed by General Atomics is briefly outlined; the experiments made at the CNEN with the RC-1 reactor and the controls made in order to verify the agreement of the data are described. The results are shown graphically. (J.S.R.)

25733 SWIMMING POOL REACTOR. Ageron, Paul; Denielou, Guy (to Commissariat a l'Energie Atomique). British Patent 1,067,914. May 10, 1967. Priority date Oct. 30, 1963, France.

A swimming pool reactor with vertical fuel elements, cooled by a rising flow of water is described. An opening slightly above the top of the core provides water to be cooled and decontaminated to be removed and a circuit provided for the same water to be returned to the pool is described. (J.C.W.)

25734 CONFIRMATORY EXPERIMENTAL DATA ON THE HARWELL BORON PILE $\bar{\nu}$ VALUES. Colvin, D. W.; Sowerby, M. G.; MacDonald, R. I. (Atomic Energy Research Establishment, Harwell, Eng.). Vienna, International Atomic Energy Agency, 1966, Preprint No. CN-23/33. 16p. (CONF-661014-35). DTIE.

From IAEA Conference on Nuclear Data, Paris.

The $\bar{\nu}$ values obtained by the Harwell boron pile experiment, which have previously been reported (Symposium on the Physics and Chemistry of Fission, Vol. II, p. 24, 1965), are approximately 2% lower than the values obtained with large liquid scintillators and those derived from measured values of η and α. The value of pile efficiency used in these measurements was obtained by using the associated particle technique, i.e., the d(γ,n)p reaction. Two standard neutron sources, a Ra-γ-Be source and the AWRE ^{240}Pu spontaneous fission source, have now been calibrated at the National Physical Laboratory, Teddington, England, and in the boron pile. The count rates of the standard sources in the boron pile can be used to obtain a second independent value of the pile efficiency and hence give information on the correctness of the boron pile $\bar{\nu}$ values. The results of these measurements are given together with other information, which demonstrates that the correction procedures used in the boron pile experiment are valid. (auth)

Reactor Components, Fuels and Accessories

Refer also to abstracts 24738, 24739, 24823, and 24826.

25735 (AAEC/TM-338) THE MECHANICAL PROPERTIES OF BeO-(UTh)O_2 DISPERSION FUELS. Veevers, K.; Rotsey, W. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug. 1966. 37p. Dep.

Dispersions of (UTh)O_2 in BeO were fabricated using (UTh)O_2 particles made from mixed powders of UO_2 and ThO_2 or by coprecipitation of UO_2 and ThO_2. The behavior of the dispersions was studied by measuring the modulus of rupture and Young's modulus. Modulus of rupture measurements were made by four-point bending of cylindrical specimens, and Young's modulus was calculated from the deflection of rectangular beams. The out-of-pile control specimens for two irradiation experiments, X121 and X105, were also tested. Examination of matching fracture faces showed that cracks passed through (UTh)O_2 particles, indicating that they were bonded to the matrix. The results were compared with previous results on BeO-ThO_2 dispersions. The strength of dispersions of (UTh)O_2 in BeO decreased with increasing (UTh)O_2 particle size and increasing (UTh)O_2 concentration. (J.R.D.)

25736 (AAEC/TM-352) STABILITY OF FISSILE-FERTILE OXIDE SOLID SOLUTIONS IN AIR. Reeve, K. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct. 1966. 12p. Dep.

The stability of (UTh)O_2, (PuTh)O_2, and (PuUTh)O_2 solid solutions when heated to high temperatures in air is reviewed and discussed. (PuTh)O_2 is chemically stable under these conditions, but compositions containing U oxidize to give either a non-stoichiometric fluorite phase containing excess O, or to this phase plus orthorhombic U_3O_8. U_3O_8 formation is to be avoided if maximum dimensional stability is required. (UTh)O_2 compositions containing 50 mole % or more of ThO_2 do not form an orthorhombic phase under any conditions of oxidation. Information on the extent of non-stoichiometry and the effects of excess oxygen on unit cell volume, bulk volume, and the rate of uranium loss at high temperatures is also reviewed. (auth)

25737 (AECL-2588) MICROSCOPIC, AUTORADIOGRAPHIC, AND FUEL/SHEATH HEAT TRANSFER STUDIES ON UO_2 FUEL ELEMENTS. Bain, A. S. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1966. 79p. Dep. CFSTI. AECL $2.00.

UO_2 fuel elements, sheathed in Zircaloy or stainless steel, were irradiated under controlled conditions to study the transfer of heat across the fuel-to-sheath interface. Variables studied were diametral clearance, heat-transfer medium, duration of irradiation and power rating. Elements were irradiated in the low pressure (10°C coolant) Hydraulic Rabbit for up to forty minutes, or in a pressurized (240°C) water loop for one or two months. After irradiation, fractured and polished cross-sections and β-autoradiographs were examined to determine the temperature distribution in the UO_2. Temperature markers were the extent of melting in the highly rated elements, and the limit of discernible grain growth in those at lower ratings. The power rating of each element was calculated from the activation of Co monitors. Fuel surface temperatures were deduced from a standard plot of integrated thermal conductivity versus temperature. The heat-transfer coefficient increased with increasing power per unit length. With lead-bonding, values of heat-transfer coefficients varied widely. Metallographic examination showed that the lead had moved from some areas of the interface, leaving gaps having poor heat transfer. In large clearance loop elements, the free standing sheathing decreased in diameter due to multi-axial forces arising from the axial expansion and the lack of diametral restraint. (auth)

25738 (EUR-3296.e) PROCOPE: A CODE TO EVALUATE COLLISION PROBABILITIES IN PIN CLUSTERS AND INFINITE ROD LATTICES. Daolio, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr. 1967. 109p. Dep.

The computer code PROCOPE, written in Fortran II for the IBM 7090, evaluates directional collision probabilities (normal and reduced) in pin clusters or infinite rod lattices. (auth)

25739 (ORNL-P-2978) UTILIZATION OF THE OAK RIDGE RESEARCH REACTOR TO STUDY THE MECHANISM OF FISSION-GAS RELEASE FROM REACTOR FUELS. Carroll, R. M.; Sisman, O.; Perez, R. B.; Watson, G. M. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 27p. (CONF-670501-6). Dep. CFSTI.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

The parameters that control the release of fission gas during irradiation were examined. Complementary studies were conducted on pyrolytic-carbon-coated fuel particles to evaluate the integrity of pyrocarbon coatings during irradiation. Results are included on fission-gas release from UO_2 as affected by temperature and metallographic defects. Oscillation methods were used to test models evolved from the results. (J.R.D.)

25740 (SC-CR-67-2571) EFFECT OF NUCLEAR RADIATION ON OXIDIZED SILICON SURFACES. Hood, Jerry A. (New Mexico Univ., Albuquerque. Bureau of Engineering Research). Dec. 1966. Contracts AT(29-1)-789; 11-8499. 130p. (EE-139). Dep. CFSTI.

Thesis.

For Sandia Corp., Albuquerque, N. Mex.

The SiO_2 is modeled using energy band characteristics. The total energy deposited in the oxide due to the radiation flux is converted to free-electron and trapped-hole pairs. The transport and recombination of the electrons result in a positive charge in the oxide. The distribution of these positive charges depends on properties of the oxide, the energy absorbed from the radiation, and the bias voltage across the oxide at the time of irradiation, and is used to calculate the change in the relation between the bias voltage across the oxide and the charge induced in the silicon surface. The positive charges in the oxide are stable for many months and temperatures well in excess of 200°C are required for annealing in any reasonable time. The radiation damage at the interface could not be resolved uniquely. The introduction of energy states at the interface could not be distinguished from a decrease in free carrier mobility at the surface because of measurement errors. By assuming that the surface mobility was constant and not affected by the nuclear radiation, the introduction of interface energy states is characterized. It was also assumed that no interface energy states were introduced and the change in surface mobility caused by the nuclear radiation is characterized. Since the true effect is not known at this time, either a constant mobility or zero interface states can be assumed and the behavior of the devices described. This gives a model to the observed radiation-induced change in electrical parameters of these types of devices. By applying the model, device types and design changes can be compared for radiation tolerance. (auth)

25741 (SGAE-RT-10/1967) INFLUENCE OF LONG-TERM PLUTONIUM VALUE CHANGES ON FUEL CYCLE COSTS OF PLUTONIUM FUELLED REACTORS. Gruemm, H.; Nathschlaeger, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). 1967. 19p. (CONF-670306-3). Dep.

From IAEA Symposium on Uses of Plutonium as a Reactor Fuel, Brussels, Belgium.

Simplified condensed analytical expressions related to various reactor types are used to analyze fuel cycle costs of power reactors operating under conditions of changing fuel prices during station lifetime. The calculation methods are limited to conditions of linear price changes. The procedure is based on the present worth procedure and represents a simplification of the formula developed by H. Schmale. (J.R.D.)

25742 (ORNL-tr-1605) PRACTICAL TEST OF AUTOMATIC PLUGGING INDICATORS. Delisle, J. P. Translated for Oak Ridge National Lab., Tenn., from paper Presented at IAEA Symposium on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna, Austria, Nov. 29–Dec. 2, 1966. 23p. (CONF-661110–19). Dep. CFSTI. JCL $2.60 fs, $0.89 mf.

A practical test of automatic plugging indicators for liquid-metal cooled reactors is described. The operation and performance of the indicators in experimental loops is discussed. (B.G.D.)

25743 FIRST-FLIGHT COLLISION PROBABILITIES IN PIN CLUSTERS AND ROD LATTICES. Amyot, L. (CCR-EURATOM, Ispra, Italy); Benoist, P. Nucl. Sci. Eng., 28: 215-25(May 1967).

A new method is presented for calculation of directional probabilities of interaction in pin clusters and rod lattices. The theory has been programmed for the IBM-7090 as the computer code PROCOPE. Calculation results for Dancoff correction factors and collision probabilities are compared with values obtained with other methods. The validity of the technique is also checked by evaluating the fine structure of the thermal flux distributions in various gas-cooled clusters upon which measurements have been made at Saclay. As a practical illustration, a series of curves describes the behavior of the various independent fuel-to-fuel collision probabilities in 19 (or 7) pin gas-cooled clusters. Finally, approximate formulas are given for the pin-to-pin collision probability at both the white and the black limits. (auth)

25744 ANALYSIS OF REACTOR CONTAINMENT. Oki, Arahiko; Hayashi, Tsutomu (Hitachi, Ltd., Tokyo). Hitachi Hyoron, 48: No. 7, 15-18(July 1966). (In Japanese).

In light-water power reactor plants, the reactor and radioactive materials are contained by the containment vessel to prevent the dispersion of radioactive materials into the surrounding area in case of a reactor accident. Methods are presented for calculation of the changes of pressure in boiling water reactors in the standard containment vessel and the pressure-suppression type vessel at the time of a maximum credible accident. The analyses were made by simplifying the complex phenomena; the results showed good agreement with experimental measurements. Many problems remain for further study, including the outward flow of saturated water, condensation of the steam containing a noncondensible gas, and the behavior of water in which steam has been ejected. (NSA of Japan)

25745 ANALYSIS OF CLADDING MATERIALS FOR NUCLEAR FUELS. Sugawara, Yasushi; Sakai, Kaoru (Hitachi, Ltd., Tokyo). Hitachi Hyoron, 48: No. 9, 80-4(Sept. 1966). (In Japanese).

An investigation was made on the analytical methods for Zircaloy, used as a cladding material for nuclear fuels, and the following techniques were found to be suitable for the routine analyses. (1) Chemical methods: For Al, Mn, Fe, Ni, Cr, Cu, Sn, Si, Cl, and Ti, the JIS methods are applicable. The electroconductivity method is for C. N_2 is measured by photometric determination of the coloration after the steam distillation. (2) Emission spectrochemical analyses: (a) For Hf, its oxide sample is mixed with graphite powder and BaF and determined by exciting with a 25 Å arc. (b) For B and Cd, their oxide sample is mixed with 6% AgCl and determined by the primary spectrum by exciting with a 16 Å arc. (c) Ca, Co, Mg, Mo, Mn, Pb, Ti and Al are determined by the secondary spectrum by exciting the sample mixed with 30% AgCl with a 20 Å arc current. (3) Gas analyses; (a) For H, the sample gas is extracted at 1650° for 10 minutes, using a vacuum fusion gas analyzer. (b) For O_2, Pt is used as the fusion metal-bath and the sample gas is extracted at 1980°C for 10 minutes. (NSA of Japan)

25746 TEMPERATURES IN THE END-CAP REGION OF CYLINDRICAL NUCLEAR FUEL RODS WITH ISOLATED TABLETS IN STATIONARY OPERATION. Hudritsch, Walter (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 9: 113-18(Feb. 1967). (In German).

The equations for temperatures in fuels, in an isolated tablet at the end of the fuel column, and in the connecting end caps for fuel rods coupled longitudinally and for free fuel rods are given for an assumed constant power generation. For the common fuel rod dimensions approximations are given, which allow numerical evaluation. For an irradiation experiment using short fuel rods with Zr–Cu cladding, the relations are numerically evaluated. (tr-auth)

25747 FUEL ELEMENT FOR A NUCLEAR REACTOR. Thomson, W. B. (to U. S. Atomic Energy Commission). U. S. Patent 3,321,378. May 23, 1967.

A design for a rotating disk fuel assembly for a compact, air-cooled nuclear reactor is presented. The disk is formed of a moderating material having a plurality of recesses, a large number of small fuel pebbles being disposed in each recess. Perforations in the disk permit cooling air to pass over the fuel pebbles. (auth)

25748 CANNED FUEL ROD AND FUEL SHEET ELEMENTS FOR NUCLEAR REACTORS. Mogard, J. H. (to Aktiebolaget Atomenergi). Swedish Patent 204,325. May 17, 1966. Filed Sept. 30, 1957.

A fuel body of ceramic or metallic material capsuled in a protecting or supporting can basically filled in its lateral direction by the fuel body was developed. The fuel body is divided into fairly long sub-bodies. The common can is provided with a locking device between each two sub-bodies to form an empty space at ambient temperature offering just enough thermal expansion for the fuel sub-body at the highest operation temperature. (Swed)

25749 FUEL ELEMENT ASSEMBLY. Hutter, Ernest (to U. S. Atomic Energy Commission). U. S. Patent 3,317,398. May 2, 1967.

Fuel element assemblies of the rod-type have a special hexagonal shape and can be brought together in a square lattice. In a reactor designed for fuel element assemblies of the plate-type fitting together in a square lattice, the plate-type assemblies may be replaced by the present rod-type assemblies. (auth)

25750 FILM BOILING INDICATOR. Ogle, H. M. (to General Electric Co.). Canadian Patent 750,509. Jan. 10, 1967.

Detectors responsive to red and infrared radiation are placed within a reactor near the fuel elements. Immediately following film boiling, a signal alerts the operator or instrumentation which is provided to reduce the power to a safe level. (F.S.A.)

25751 FLEXIBLE CLAD NUCLEAR FUEL ELEMENT. Zebroski, Edwin Leopold (to General Electric Co.). British Patent 1,069,043. May 17, 1967. Priority date Dec. 26, 1962, United States.

A design is given for a fuel element having a cladding with longitudinal ridges which allows for radial expansion due to pressure differentials. The ridges allow the fuel material to contact at least part of the inner surface of the clad tube under conditions varying from ambient temperature to normal reactor operating conditions. (M.L.S.)

25752 AN ARRANGEMENT FOR SHIELDING AGAINST RADIOACTIVE RADIATION ORIGINATING IN A GAS-COOLED NUCLEAR REACTOR. Machnig, Oskar; Oettl, Hans (to Brown Boveri/Krupp Reaktorbau GmbH). British Patent 1,069,036. May 17, 1967. Filed Apr. 30, 1965.

A design for a shielding filter is given. A loose filler material is located within the pressure vessel and contained by fixed walls. The reactor coolant is passed through the filler thereby having contaminants removed. (M.L.S.)

25753 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Clapham, Leslie (to United Kingdom Atomic Energy Authority). British Patent 1,069,321. May 17, 1967. Filed Jan. 14, 1964.

A design for a fuel element with sheath having planar heat transfer fins. The fins are at an angle which is against the longitudinal axial flow of the coolant and provide good heat transfer. (M.L.S.)

GENERAL

25754 (BNWL-387) TECHNICAL PUBLICATIONS OF BATTELLE-NORTHWEST DURING 1966. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT(45-1)-1830. 42p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A list is presented of formal research and development reports and technical articles published at Battelle-Northwest during 1966. (C.H.)

25755 (NIRS-5) ANNUAL REPORT [ON RADIOLOGICAL SCIENCES], 1965. (National Inst. of Radiological Sciences, Chiba (Japan)). Dec. 1966. 84p. Dep. mn.

Separate abstracts have been prepared for the eight sections of this report. (W.E.B.)

For abstracts of individual sections see: 24067, 24294, 24376, 24410, 24411, 24454, 24546, and 24547.

25756 (ORNL-4112) CRITICAL PATH TIME-COST SCHEDULING FOR MANAGEMENT OF RESEARCH AND DEVELOPMENT PROJECTS. Goolsby, W. W.; Snyder, F. T. (Oak Ridge National Lab., Tenn.). May 1967. Contract W-7405-eng-26. 85p. Dep. CFSTI.

A method of managing research and development projects that incorporates a system of cost control with critical path scheduling has been developed at Oak Ridge National Laboratory, and the method is currently being used on selected projects at the Laboratory. This method serves the needs of the project managers in planning, analyzing, and controlling projects from their inception through their completion. Designed as a general-purpose system that makes maximum use of the automated processing of information, the scheduling system permits management to obtain a coordinated set of time and resource schedules with the option of resource leveling. The cost system uses the information generated by the scheduling system to collect and report detailed costs for labor, material, and equipment. The actual expenditures of time, manpower, and dollars are then compared with the estimated expenditures and the scheduled progress. The development of this time-cost method of project management at Oak Ridge National Laboratory is discussed in this report, and the functions of the scheduling and cost systems, the input requirements for the computer programs, the computer reports, and the options available are described. (auth)

25757 (SC-CR-67-2547) STUDY OF LEARNING IN ADAPTIVE SYSTEMS. Koschmann, Arnold H.; Kang, In Ku (New Mexico Univ., Albuquerque. Bureau of Engineering Research). Aug. 1966. Contract AT(29-1)-789. 189p. (EE-135). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Albuquerque, N. Mex.

The structures of the learning process and their applications to adaptive systems are investigated. The learning processes are based on Bayes' learning model and are constructed in such a way that they are applicable even if the observations are not classified (unsupervised learning). Bayes' learning process has been the subject of much active research in recent years, but most studies were based on the assumption that the observations could be classified by some external aids or by decision-direction. Even in this case, few works have been done on the behavior with time varying parameters or on the rate of convergence. The concept of a quantized parameter space is introduced to handle a general type of the prior credibility function and unsupervised learning, and is applied to develop the structures of the learning processes for various communication channels. The adaptive detectors, whose performances are arbitrarily close to the optimum, are then developed as applications of these structures. The learning process is also applied to the adaptation of transmission rate according to the channel characteristics and to obtain the channel parameter of a quantized channel from the characteristics of a physical channel. For the binomial random variable, it is shown that a prior learning sometimes hinders the present learning in a time varying case. The contributions of various parameters to this overlearning are investigated, as well as some methods suitable for time varying parameters. A measure of the rate of convergence is proposed, and it is shown that, for some stationary channels, such a measure is an exponential function of the number of observations. Also some examples of adaptive systems are simulated on a digital computer to investigate their performances. The results of the simulation show that such systems are feasible and that their performances are superior, in most cases, to those of the conventional methods. (auth)

25758 (SC-R-67-1095) ENVIRONMENTAL ENGINEERING ABSTRACTS. (Sandia Corp., Albuquerque, N. Mex.). Jan. 15, 1967. Contract AT(29-1)-789. 20p. DTIE.

A bibliography is presented which contains 61 references to published literature on environmental engineering. (R.C.K.)

25759 (TID-3740) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE, Issued or in Progress During the Period February 1967-March 1967. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Apr. 4, 1967. 16p. DTIE Free.

Nine bibliographies received by DTI Extension, Oak Ridge, from the AEC or AEC contractors are listed. Thirty-two non-AEC bibliographies are listed. A list of 31 bibliographies in preparation is given. A report number index is included. (H.L.W.)

25760 (UCRL-14887) COMPUTERS AND THE POLICY-MAKING COMMUNITY. Final Report. Schwartz, Judah L. (California Univ., Livermore. Lawrence Radiation Lab.). May 6, 1966. Contract W-7405-eng-48. 15p. Dep. CFSTI.

This document is intended to serve as a final report on the Computers and the Policy-Making Community Institute and is addressed to the sponsors of the Institute — the United States Atomic Energy Commission and the Carnegie Endowment for International Peace. Included is a description of the program planning and physical arrangements as well as a preliminary evaluation of the success of the effort. (auth)

25761 (Y-1575) FACTORS AFFECTING THE MORALE AND PRODUCTIVITY OF ENGINEERING PERSONNEL. Beeson, H. C.; Hodges, J. W. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Apr. 27, 1967. Contract W-7405-eng-26. 190p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

Engineering personnel were investigated to determine those factors which have a significant influence on both morale and productivity. The study was conducted over a period of 18 months. The employee production data were collected during the period from April 1965 through March 1966. The data included the total number of engineering drawings produced by each draftsman for a year period. The engineer's productivity was judged on the basis of the number of engineering design drawings for which he was accountable. The supervisor's productivity was measured in terms of his section's drawing production. These data were used to rank the personnel. Two questionnaires were issued in the study. The first questionnaire was issued to obtain a list of suitable incidents which resulted in morale and productivity level change. The second questionnaire consisted of the most frequently mentioned factors from the first questionnaire. The employee was asked to check those incidents which he had experienced and mark a scale indicating his morale level. The data from the second questionnaire and the productivity rankings were then analyzed to determine which factors significantly affected morale and productivity between high and low producers, high and low morale personnel, and high and low morale and productivity personnel. Morale and productivity increased in the study group when (a) the employee's job was considered interesting and challenging, (b) the employee received consistent and considerate behavior from his supervisor, (c) the employee received long range and immediate reward for doing a good job, (d) the employee was given sufficient responsibility and freedom, (e) the employee was made to feel a part of the team, and (f) the employee was kept informed of his progress. Morale and productivity decreased in the study group when (a) the employee was given no salary increase with insufficient explanation, (b) the supervisor took credit for an employee's efforts, (c) the employee was subjected to pressure and inconsiderate supervision, (d) the supervisor used inconsistent behavior in employee relations, and (e) the supervisor failed to give adequate performance reviews. (auth)

25762 (Y-IA-44) PUNCHED-TAPE READ-IN CIRCUIT IMPROVEMENTS FOR NUMERICAL CONTROL. Reedy, K. B. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Apr. 25, 1967. Contract W-7405-eng-26. 8p. Dep. CFSTI.

Numerical control units applied to machine tools receive dimensional command information for coded perforated tape. Misalignment of the punched holes can occasionally result in loss of information which results in incorrect machine movements. A circuit which eliminates this possibility was designed and installed on a Bendix Dynapath 20 control unit. (auth)

25763 XVth INTERNATIONAL ASTRONAUTICAL CONGRESS, WARSAW, 1964. VOLUME II. SATELLITE SYSTEMS. Lunc, Michal (ed.). Paris, Gauthier-Villars and Warsaw, Polish Scientific Publishers, 1965. 376p. (CONF-640932-(Vol.2)).

Twenty-six papers on uses and systems of various types of satel-

lites are presented. Principal topic areas are: geodetic satellite systems, meteorological satellite systems, communication satellite systems, and ground installations. (J.H.M.)

25764 XVth INTERNATIONAL ASTRONAUTICAL CONGRESS, WARSAW, 1964. VOLUME III. PROPULSION, POWER, AND RE-ENTRY PROBLEMS. Lunc, Michal (ed.). Paris, Gauthier-Villars and Warsaw, Polish Scientific Publishers, 1965. 654p. (CONF-640932-(Vol.3)).

Twenty-eight papers are presented under the following principal topic areas: physical problems of re-entry into planetary atmosphere, power systems for space vehicles, and propulsion technics. (J.H.M.)